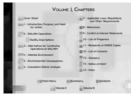

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4

Affected Environment

CHAPTER 4

Affected Environment

4.1 INTRODUCTION

Understanding the affected environment is necessary for understanding potential impacts from operations at Sandia National Laboratories/New Mexico (SNL/NM). This chapter describes the existing conditions that comprise the physical and natural environment within SNL/NM, the Region of Influence (ROI), and the relationship of people with that environment. Descriptions of the affected environment provide a framework for understanding the direct, indirect, and cumulative effects of each of the three alternatives. The discussion is categorized by resource area to ensure that all relevant issues are included. This chapter is divided into the following 13 resource areas, and also includes other topic areas that support the impact assessment discussed in Chapter 5:

- Land Use and Visual Resources
- Infrastructure
- Geology and Soils
- Water Resources and Hydrology
- Biological and Ecological Resources
- Cultural Resources
- Air Quality
- Human Health and Worker Safety
- Transportation
- Waste Generation
- Noise and Vibration
- Socioeconomics
- Environmental Justice

The information in this chapter comes primarily from the SNL/NM *Environmental Information Document* (SNL/NM 1997a) and from the comprehensive environmental monitoring and surveillance programs that the U.S. Department of Energy (DOE) maintains at SNL/NM. Data for 1996 are presented where available; data for 1992, 1993, 1994, and 1995 are also included where necessary to present trends. Other relevant information is summarized and incorporated by reference.

Regions of Influence

Each ROI—the area that SNL/NM operations may reasonably affect—is delineated by its resource. The ROIs are determined based on characteristics of SNL/NM and the surrounding area. The ROI limits may be natural features (such as the extent of the Albuquerque-Belen Basin aquifer for groundwater) or political boundaries (such as the immediate four-county area for socioeconomics).

Other ROIs are delineated using industry-accepted norms for the resources (such as the 50-mi radius used in radiological air quality).

Each resource and topic area includes a discussion of the ROI—the area that may be affected by SNL/NM operations. The ROI establishes the scope of analysis and focuses the discussion on relevant information. Because resource and topic areas are often interrelated, one section may refer to another.

Materials (including chemicals and radioisotopes) released from SNL/NM can reach the environment and people in a number of ways. The routes that materials follow from SNL/NM to reach the environment and subsequently people are called transport and exposure pathways. SNL/NM conducts environmental monitoring to measure both radioactive and nonradioactive materials released into the environment.

Transport and Exposure Pathways

The routes that released materials follow to reach the environment and subsequently people involve both transport and exposure pathways. A transport pathway is the environmental media, such as groundwater, soil, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater). An exposure pathway is how a person or other organism comes in contact with the contaminant (for example, breathing, drinking water, or skin contact).

Environmental monitoring assesses the potential for people to come in contact with these materials by any route of exposure. Sampled media include groundwater, storm water runoff, wastewater discharge, vegetation, soil, and air. SNL/NM publishes an annual site environmental report that contains details on these sampling programs (SNL 1994b, 1995c).

4.2 GENERAL LOCATION

SNL/NM is located within Kirtland Air Force Base (KAFB), approximately 7 mi southeast of downtown Albuquerque, New Mexico (Figure 4.2–1). SNL/NM uses approximately 8,800 ac of Federal land on KAFB (SNL/NM 1997a). Albuquerque is located in Bernalillo county, in north-central New Mexico, and is the state's largest city, with a population of approximately 420,000 (Census 1997a). The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and towns of Los Lunas and Belen to the south.

4.3 LAND USE AND VISUAL RESOURCES

4.3.1 Land Use

4.3.1.1 Definition of Resource

Land use describes the activities that take place in a particular area. It is a critical element in site operations decision-making. It is especially important as a means to determine if there is sufficient area for site activities and required buffers and to identify conflicts between existing or projected onsite and offsite programs and operations. DOE P 430.1 governs DOE's management of its land and facilities as valuable natural resources, based on the principles of ecosystem management and sustainable development.

4.3.1.2 Region of Influence

The ROI consists of the land SNL/NM uses in and adjacent to KAFB. It represents probable impact areas differentiated by onsite or offsite land resources. Onsite resources are lands used for SNL/NM activities within KAFB. Offsite resources consist of land immediately adjacent to KAFB and include areas belonging to the Pueblo of Isleta, city of Albuquerque, state of New Mexico, and the U.S. Forest Service (USFS).

4.3.1.3 Affected Environment

KAFB is an Air Force Materiel Command Base southeast of Albuquerque, New Mexico. KAFB shares facilities and infrastructure with several associates, including the DOE and its affiliates (for example, SNL/NM). It is comprised of approximately 51,560 ac of land, including portions of Cibola National Forest withdrawn in cooperation with the USFS. It is geographically bounded by the Pueblo of Isleta to the south, the Albuquerque International Sunport and lands held in trust by the state of New Mexico to the west, and the city of Albuquerque to the north. The eastern boundary lies within the Manzanita Mountains (Figure 4.3–1) (SNL/NM 1997a).

Historical Land Use Within KAFB

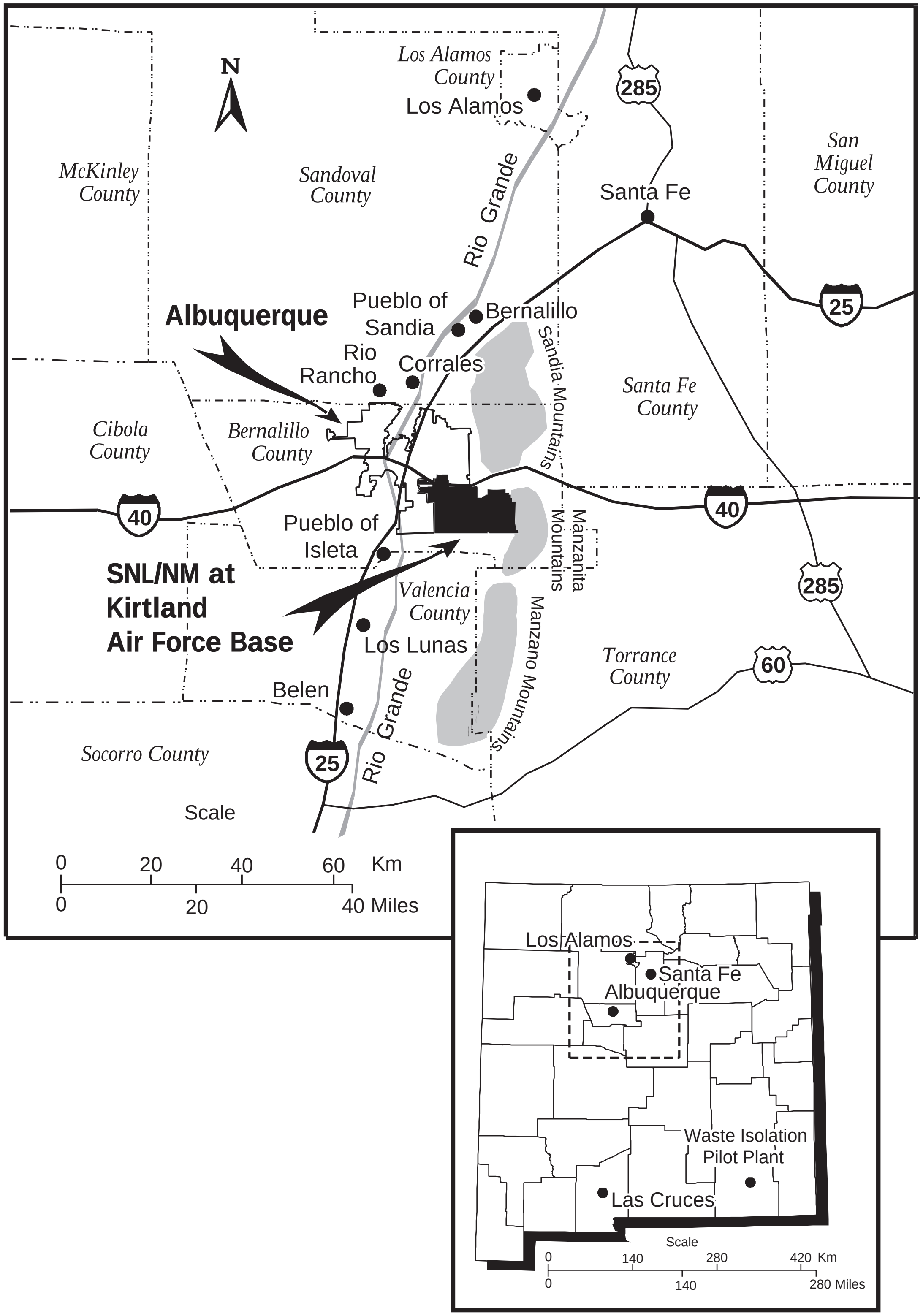
The earliest land use in the KAFB area is attributed to Native Americans and appears to have encompassed hunting, plant gathering, woodcutting, grazing, and possibly ritual activities (Holmes 1996a). No known Spanish land grants have been identified within KAFB. Farming and ranching were the principal activities during the eighteenth and nineteenth centuries. Upon the arrival of the railroad in 1880, mining activity increased and new residents established homesteads. New Mexico became a territory in December 1850 and a state in January 1912.

KAFB's military and civilian history began with the establishment of the city's first airfield in 1928. Beginning in 1942 and throughout World War II, Los Alamos operations, associated with the Manhattan Engineering District, used the area to assist in transportation requirements for the nation's first atomic weapons program (SNL/NM 1997a).

In 1945, jurisdiction over the site that eventually became SNL/NM was transferred to the Manhattan Engineering District, which established the forerunner of SNL/NM. SNL/NM developed and expanded its facilities throughout the Cold War era and to the present. KAFB itself has also continued as a military base and multi-user industrial research and development complex (SNL/NM 1997a).

Land Ownership Within KAFB

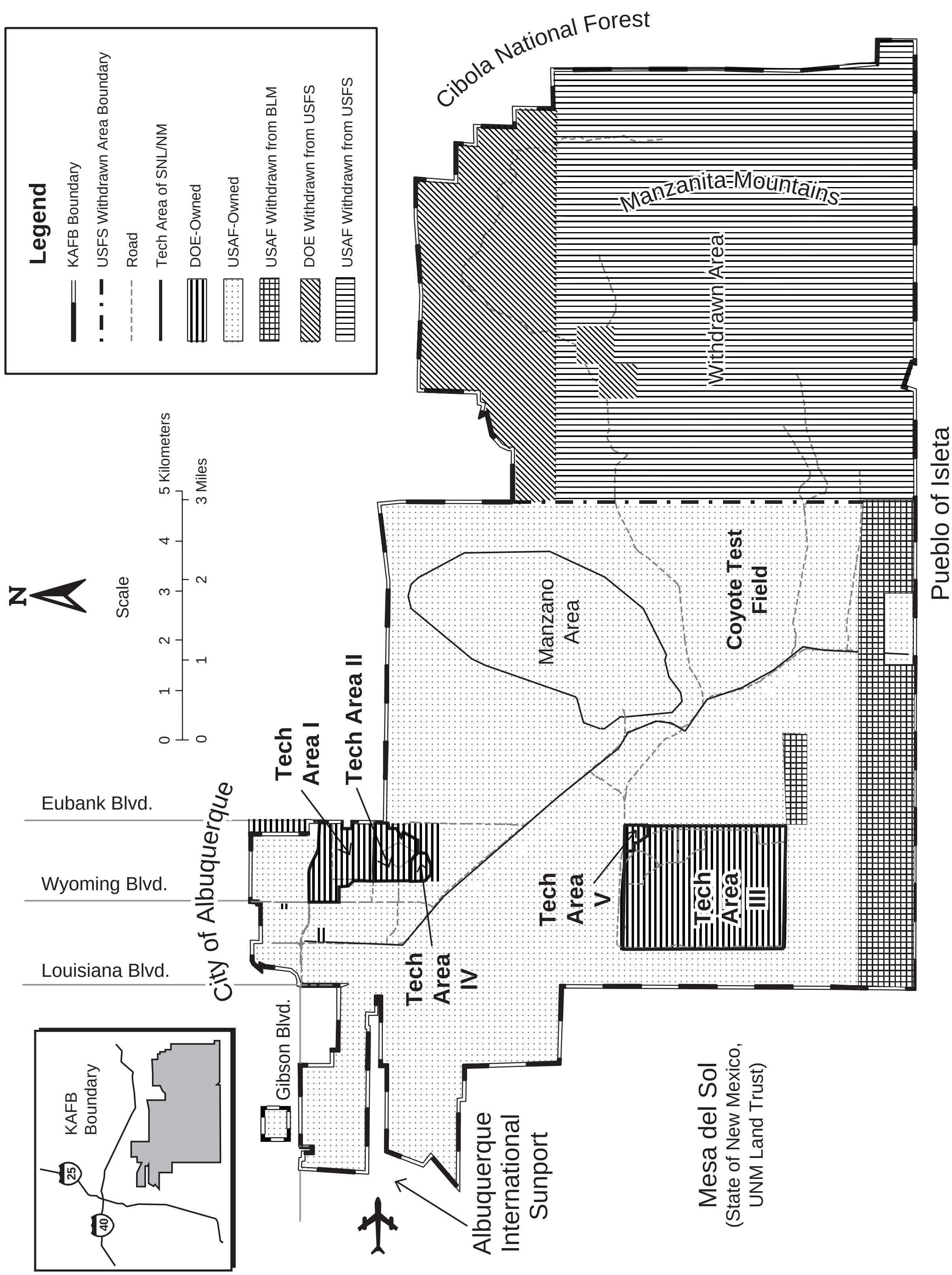
Land ownership on KAFB is divided primarily among the U.S. Air Force (USAF), the DOE, the Bureau of Land Management (BLM), and the USFS (Figure 4.3–1;



Source: SNL/NM 1997j

Figure 4.2–1. General Location of KAFB

KAFB is located southeast of the city of Albuquerque in Bernalillo county.



Source: SNL/NM 1997j

Figure 4.3–1. KAFB Land Ownership

KAFB, occupying approximately 51,560 acres, is primarily owned by the U.S. Air Force, the DOE, the Bureau of Land Management, and the U.S. Forest Service.

Table 4.3–1). The majority of acreage comprising the western half of KAFB is owned by the USAF. The DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land in the southwestern half is owned by the BLM and has been withdrawn by the USAF. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 20,480 ac of USFS land within the Cibola National Forest that has been withdrawn by the USAF and the DOE in separate actions.

Table 4.3–1. KAFB Land Ownership

OWNER	ACREAGE	PERCENT OF KAFB
USAF	25,586	49
USFS (Withdrawn by USAF)	15,891	31
USFS (Withdrawn by DOE)	4,595	9
DOE	2,938	6
BLM (Withdrawn by USAF)	2,549	5
TOTAL	**51,559**	**100**

Sources: SNL/NM 1997a, j
BLM: Bureau of Land Management
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
USAF: U.S. Air Force
USFS: U.S. Forest Service

Land Use Within the KAFB

The USAF and the DOE are the principal land users within the KAFB (SNL/NM 1997a) (Table 4.3–2). Land use is established through coordination and planning agreements between these agencies. On matters involving the Withdrawn Area, the USFS is also involved. The USAF operates on much of its own land, as well as on property within its portion of the Withdrawn Area. The DOE owns only a small portion of the land it needs, and is required to conduct many of its activities under permit on land owned or withdrawn by the USAF or within its section of the Withdrawn Area. The DOE also leases land adjacent to KAFB to support SNL/NM activities (see Land Use Adjacent to KAFB). SNL/NM facilities and operations encompass the majority of the DOE's land use requirements on KAFB. Other DOE-funded facilities make up the remainder. Figure 4.3–2 provides a general overview of land use on KAFB.

Table 4.3–2. KAFB Land Use

USER		ACREAGE	PERCENT OF KAFB
USAF		33,338	65
DOE	*SNL/NM*	8,824	17
	Other	6,447	12
Joint USAF/DOE		2,950	6
TOTAL		**51,559**	**100**

Sources: SNL/NM 1997a, j
DOE: U.S. Department of Energy
KAFB: Kirtland Air Force Base
SNL/NM: Sandia National Laboratories/New Mexico
USAF: U.S. Air Force

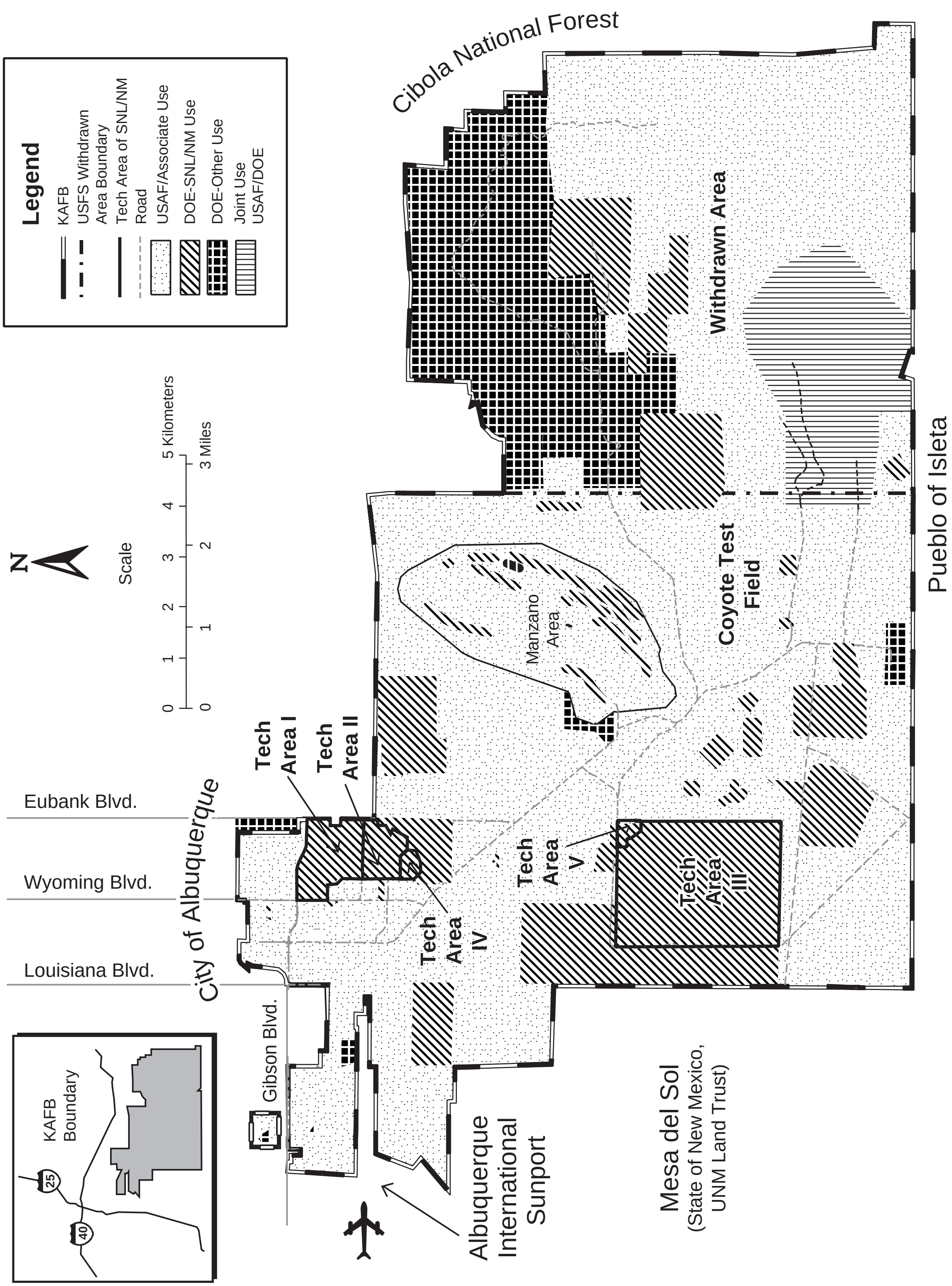
There is no single comprehensive land use plan for KAFB; however, existing land use designations and future planning scenarios are addressed in documents produced by the USAF, USFS, and SNL/NM. These documents include, for example, the *KAFB Comprehensive Plan* (USAF 1998a), *Cibola National Forest Land and Resource Management Plan* (USFS 1985), *SNL Sites Comprehensive Plan* (SNL 1997a), and *SNL Sites Integrated Master Plan* (SNL 1997c).

SNL/NM primary land use fits into a category of industrial/research park uses. This category coincides with the preliminary future use scenarios presented to the Citizens Advisory Board of the Future Use, Logistics, and Support Working Group (SNL 1997a, Keystone 1995) (see Future DOE Land Use on KAFB). Although not all facilities are industrial in nature (for example, administrative and office buildings), factors that contribute to the industrial designation include the following (SNL/NM 1997a):

- activities occurring in locations with limited area for development,
- testing activities occurring in areas near research and development facilities, and
- environmental restoration sites with associated remediation efforts resulting from research and testing activities.

In addition to SNL/NM, other DOE-funded facilities are located on land owned by the USAF and permitted to the DOE. These facilities include the Lovelace Respiratory Research Institute, Nonproliferation and National Security Institute (NNSI), Transportation Safeguards Division (TSD), Federal Manufacturing & Technology/New Mexico (FM&T/NM) (AlliedSignal), Ross Aviation, Inc., the Energy Training Center (ETC), and the DOE/Albuquerque Operations Office (AL).

KAFB land used by the USAF is also designated for industrial use, but includes a broader range of other uses such as residential, recreational, and medical activities that are associated with day-to-day base operations. Additionally, large areas of land within KAFB, particularly in the Withdrawn Area, do not support



Sources: SNL/NM 1997a, 1997j

Figure 4.3–2. KAFB Land Use

The U.S. Air Force and the DOE are the principal land users within KAFB.

specific facilities or programs, but are used as safety zones in association with USAF and DOE testing and training activities (SNL/NM 1997a).

SNL/NM Activities on KAFB

The five SNL/NM technical areas (TAs) cover approximately 2,560 ac (87 percent) of DOE-owned land. Table 4.3–3 lists DOE-owned land on and adjacent to KAFB, lists the total acreage of each SNL/NM TA, and provides a brief description of associated land use. TAs-I, -II, and -IV encompass approximately 645 ac. TAs-III and -V encompass approximately 1,915 ac. The DOE also owns approximately 10 ac that house the DOE/AL and 85 ac on the west side of Eubank Boulevard north of TA-I.

Technical Area I

TA-I comprises approximately 350 ac and is located in the northwest part of KAFB. TA-I is bordered by Wyoming Boulevard to the west and Eubank Boulevard to the east, while F and G Avenues form the northern border and Hardin Boulevard defines the southern boundary (Figure 4.3–3). Approximately 110 ac of TA-I are enclosed behind a security fence. TA-I is the most densely developed and populated of the TAs, with over 6,600 employees and 370 structures (SNL/NM 1997a). The structures within TA-I consist of laboratories, shops, offices, warehouses, and other storage buildings used for administration, site support, technical support, basic research, Defense Programs (DP), component development, microelectronics, energy programs, exploratory systems, technology transfer, and business outreach (SNL/NM 1997b). Large parking lots are also prominent features. Future SNL/NM planning efforts are directed at developing the east side of TA-I along Eubank Boulevard, with additional expansion by private entities into the area outside of the KAFB Eubank Gate (SNL/NM 1996f).

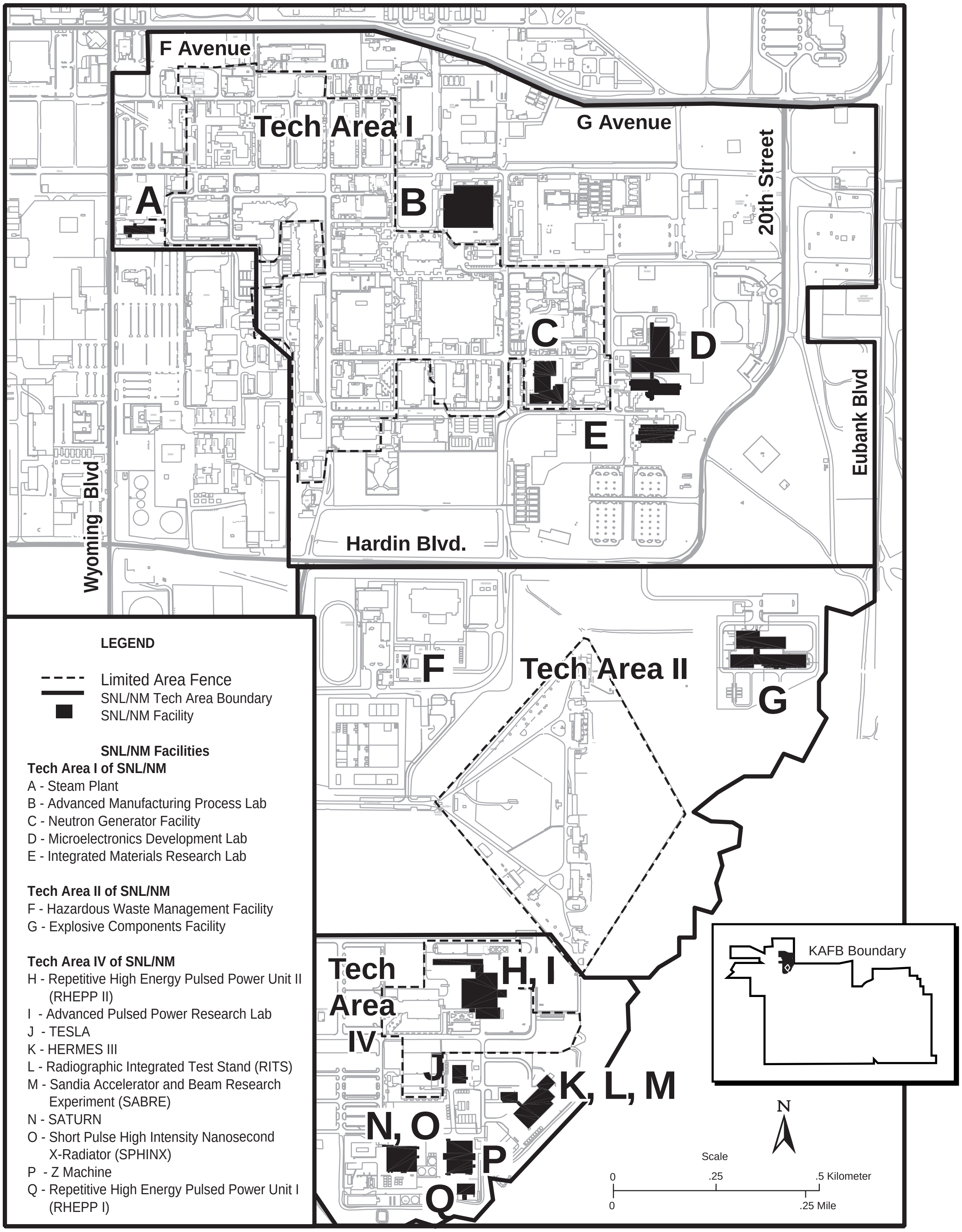
Technical Area II

TA-II is located immediately south of TA-I (Figure 4.3–3). Approximately 440 people work in the 210-ac area. TA-II includes a diamond-shaped fenced area of approximately 45 ac distinguished by a 10-ft-high chain link fence and

Table 4.3–3. DOE-Owned Land on KAFB

AREA	APPROXIMATE ACREAGE	MAJOR LAND USES
TA-I	350	Administrative buildings, laboratories, and offices associated with commercial and light industrial activities
TA-II	210	Storage and warehouse areas, light testing facilities, and maintenance yards
TA-III	1,890	20 test facilities, widely separated by large tracts of open space; a limited number of buildings and mobile office trailers for administrative, office, and light laboratory uses
TA-IV	85	Several major laboratory/research facilities with accompanying office and administrative space
TA-V	25	A small, highly secured area of several primary research facilities, light laboratories, and office space
TOTAL TA ACREAGE	**2,560**	
Tijeras Arroyo Drainage Area (Adjacent to TA-IV)	280	Undeveloped open space
DOE/AL and Coronado Club	10	Administrative buildings and office space
Eubank Boulevard Development Area	85	Undeveloped open space
TOTAL DOE LAND	**2,935**	

Source: SNL/NM 1997a
DOE/AL: Department of Energy/Albuquerque Operations Office
TA: technical area



Source: SNL/NM 1997a

Figure 4.3–3. Technical Areas-I, -II, and –IV

Technical Areas-I, -II, and -IV are located in the northwest section of KAFB.

security gate (SNL/NM 1997a, SNL 1997a). Like TA-I, the area is urbanized but less densely developed. Over 30 structures are within the area, consisting of several laboratories, limited office space, and numerous storage buildings (SNL/NM 1997b). The Explosive Components Facility (ECF), completed in 1995, is used by SNL/NM to perform low-hazard testing on small samples of explosive material. Additional facilities include the safeguards and security building, shipping and receiving, the waste transfer station, and maintenance yards. Other portions of the area have been vacated and are awaiting decommissioning and remediation activities (SNL 1997a). TA-II is fully developed; however, suitable facilities may be reassigned for use as warehouses or for other limited-occupancy uses (SNL/NM 1996f).

Technical Area III

TA-III consists of an area of about 1,890 ac located approximately 5 mi south of TA-I (Figure 4.3–4). Approximately 224 people work in the area, which is composed of 20 test facilities devoted to violent physical testing and simulating a variety of natural and induced environments (SNL/NM 1997a). Over 150 structures are located within TA-III. Most of these structures are grouped together in small units separated by extensive open spaces. These units are organized by testing facility (SNL/NM 1997b). An administrative building and mobile office trailers provide space for administrative, office, and light laboratory functions (SNL/NM 1997a). Although much of the area remains as open space characterized by flat to undulating grassland terrain, TA-III is considered fully developed due to the area required for hazard safety zones (SNL/NM 1997a). For example, testing activities associated with the 10,000-ft Sled Track Facility in the NW corner of TA-III require the leasing of a buffer zone west of the boundaries of KAFB (SNL/NM 1997a, SNL/NM 1997x). Buffer zones are discussed in more detail in the Land Use Adjacent to KAFB subsection.

Technical Area IV

TA-IV is located south of TA-II on approximately 85 ac, 19 of which are behind security fencing (Figure 4.3–3). Like TA-II, TA-IV is urbanized but less densely developed than TA-I. The area is primarily a research site for pulsed-power sciences and particle-beam fusion accelerators, as well as a research and development area. The working population of TA-IV is approximately 546, occupying about 70 structures consisting of main laboratories, mobile offices, and storage (SNL/NM 1997a, 1997b). With the exception of the adjacent 280-ac Tijeras Arroyo drainage area, TA-IV has land available for construction of additional facilities.

Technical Area V

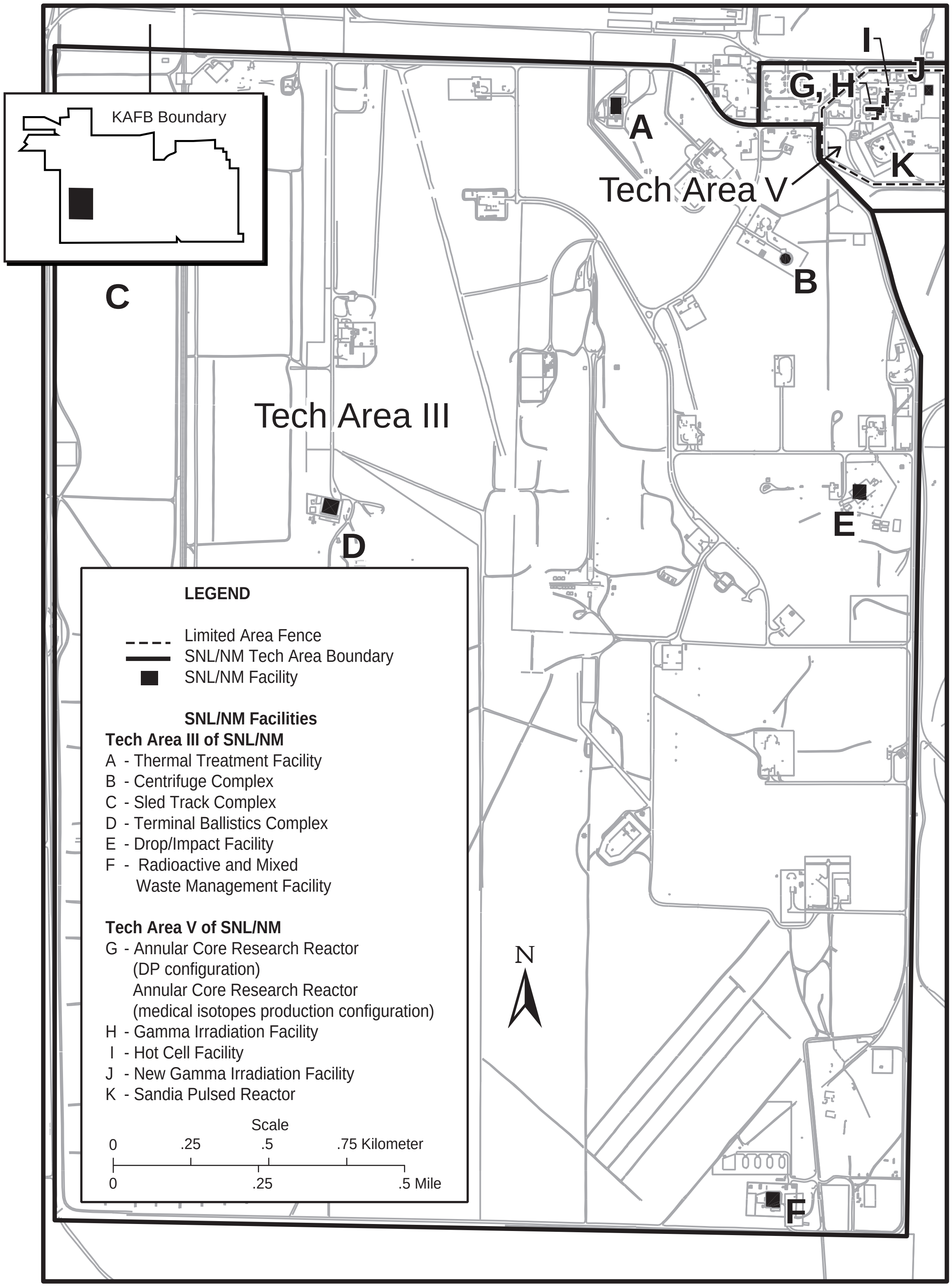
TA-V is located on approximately 25 ac adjacent to the northeast corner of TA-III (Figure 4.3–4). In addition to DOE-owned lands within the boundaries of TA-V, approximately six ac are permitted to the DOE by the USAF to provide additional security (SNL/NM 1997a). TA-V is a relatively small research area consisting of about 35 closely grouped structures where experimental and engineering nuclear reactors are located. Approximately 159 personnel work in the area.

Coyote Test Field

The Coyote Test Field (Figure 4.3–5) is a large area within KAFB that contains a variety of remote testing sites and facilities. The area is comprised of mostly open, flat to undulating, grassland terrain in the west, to more mountainous topography in the east. Approximately 173 structures consisting of laboratory buildings, mobile offices, and numerous storage areas are found widely dispersed throughout the area (SNL/NM 1997b). A number of SNL/NM facilities, such as the Explosives Applications Laboratory (EAL), Containment Technology Test Facility-West, and Thunder Range Complex, operate in this area on land permitted to the DOE by the USAF.

Withdrawn Area

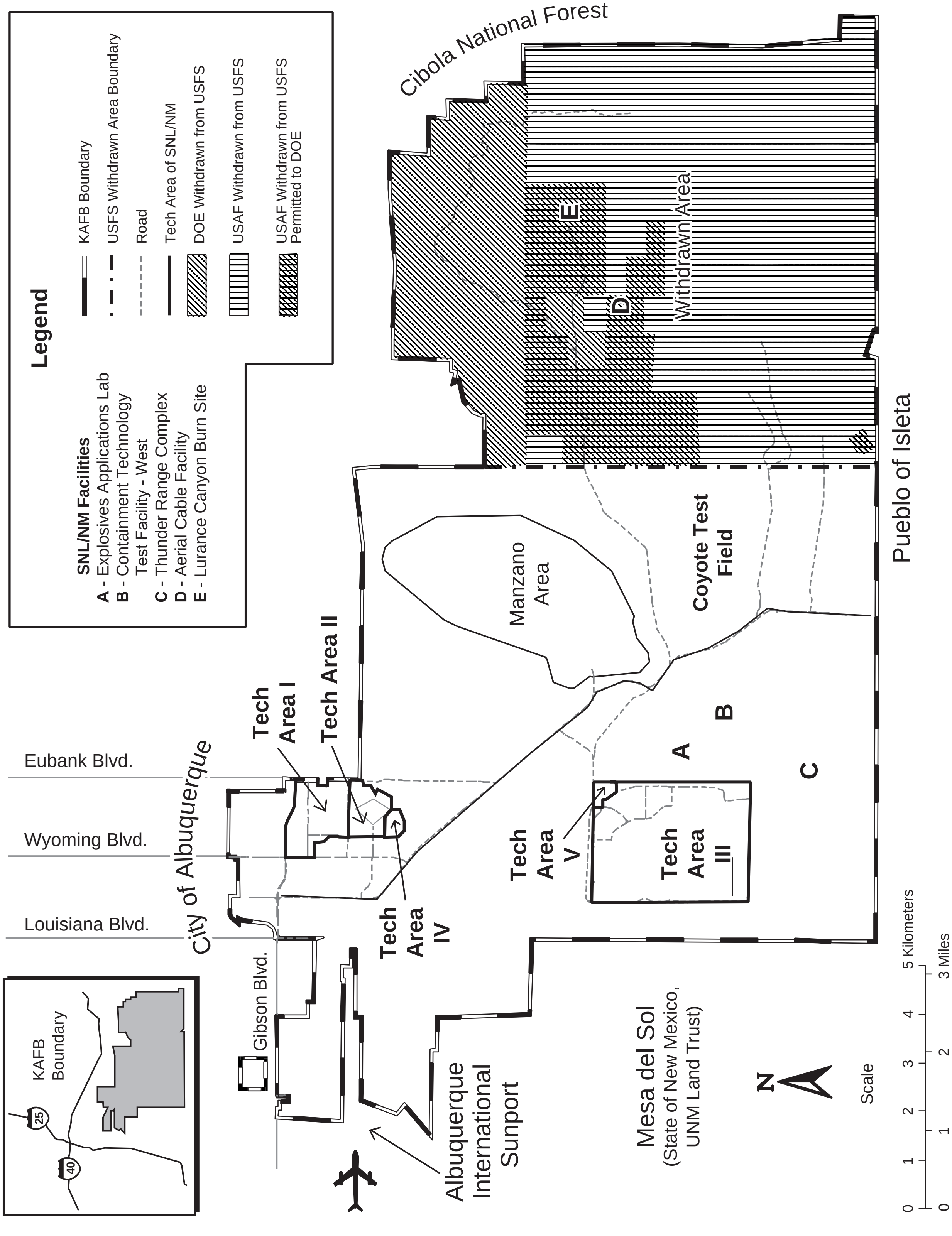
The Withdrawn Area consists of approximately 20,485 ac in the eastern portion of KAFB, including land within the Cibola National Forest that has been withdrawn from public use by the USAF (15,890 ac) and the DOE (4,595 ac) (Figure 4.3–5). SNL/NM operations at the Lurance Canyon Burn Site and the Aerial Cable Facility are conducted on land that has been withdrawn by the USAF and subsequently permitted to the DOE. There are additional SNL/NM activities on USAF-permitted land in the Withdrawn Area as well. Other DOE activities not associated with SNL/NM, such as those associated with the NNSI and the TSD, are also conducted on USAF-permitted land, as well as on that portion withdrawn specifically by the DOE (Figure 4.3–5). The terrain is predominantly mountainous with increasing elevation to the east. Development is limited and characterized by small structures and mobile offices. Large portions of land within the Withdrawn Area do not support specific facilities or programs, but are used as buffer areas for USAF and SNL/NM testing activities (SNL/NM 1997a).



Source: SNL/NM 1997a

Figure 4.3–4. Technical Areas-III and -V

Technical Areas-III and -V are located in the southwest section of KAFB.



Source: SNL/NM 1997j

Figure 4.3–5. Coyote Test Field and the Withdrawn Area

The Coyote Test Field and the Withdrawn Area occupy over 20,000 acres in the eastern portion of KAFB.

Land Use Adjacent to KAFB

Generalized land use adjacent to KAFB is shown in Figure 4.3–6. The city of Albuquerque has the most influence on land use adjacent to the north-northwestern boundary of KAFB. The city has experienced steady growth in these areas characterized by single-family and multi-family residential dwellings, mixed/minor commercial establishments, and light industrial/wholesale operations. Trending east along the northern border of KAFB, limited residential use, as well as some vacant land, is found within the city and surrounding Bernalillo county. The northeast boundary of KAFB is surrounded almost entirely by Cibola National Forest, although some private land, scattered residential dwellings, and industrial operations are present north of the Withdrawn Area. Much residential development, consisting of single-family homes, has occurred just beyond the national forest approximately 1 mi east of the KAFB Withdrawn Area boundary. The southern portion of KAFB borders a wide expanse of open rangeland owned by the Pueblo of Isleta. To the west, adjacent land consists of the Albuquerque International Sunport, some city and county open space, and a large parcel of open space planned for a significant future development known as Mesa del Sol. Mesa del Sol and a number of other planned development projects affecting adjacent land use are discussed in Chapter 6, Cumulative Effects Analysis.

DOE Buffer Zones

The DOE leases approximately 9,100 ac of land adjacent to the western and southwestern boundaries of KAFB as a buffer zone for the operations at the 10,000-ft Sled Track Complex in TA-III (Figure 4.3–7). The Sled Track Complex is an SNL/NM test facility used for simulating high-speed impacts of weapon shapes, substructures, and components to verify design integrity, performance, and fuzing (mechanical or electrical means used to detonate an explosive charge) functions. The facility also subjects weapon parachute systems to aerodynamic loads to verify parachute design integrity and performance (SNL/NM 1998a). The buffer zone ensures that an adequate safety area exists for the physical protection of the public from impact of all sled and payload components. This includes explosive debris and/or shrapnel as well as the maximum range of fly-away rocket motors (SNL/NM 1997x).

The buffer zone is comprised of two distinct areas due to land ownership and the nature of the individual arrangements between the landowners and the DOE (SNL/NM 1997a). The first part of the buffer zone consists of approximately 2,750 ac west of KAFB boundary that the DOE leases from the state of New Mexico. This area is 1 mi wide and encompasses the eastern edge of the proposed Mesa del Sol (state of New Mexico, University of New Mexico [UNM] land trust) development. The lease expired in 1995 and the New Mexico State Land Office (NMSLO) and the DOE are currently discussing its continuation. The second part of the buffer zone consists of approximately 6,345 ac, extending south and west of the southern KAFB boundary. This land is currently used under agreement with the Pueblo of Isleta through the Bureau of Indian Affairs (BIA) (SNL/NM 1997a, 1997j).

For 20 days in 1990, an agreement with the Pueblo of Isleta temporarily established an additional buffer zone of approximately 3,840 ac south of the KAFB boundary. This action was taken during special testing at the Aerial Cable Facility (DOE 1990).

The Mesa del Sol Area

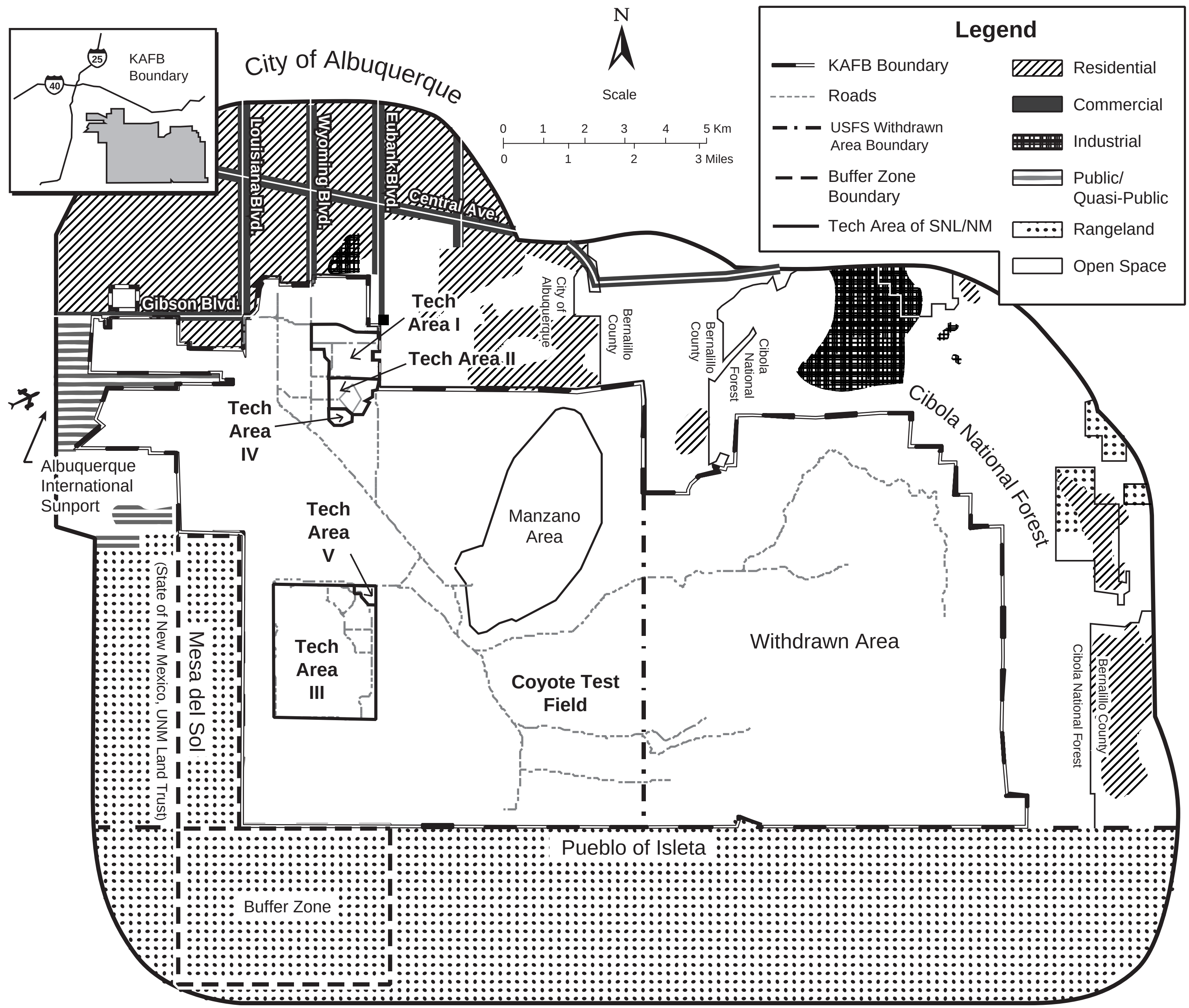
The Mesa del Sol area is a 13,000-acre parcel of vacant land, virtually all of which is held in trust by the New Mexico State Land Office (NMSLO) for the benefit of the University of New Mexico and New Mexico Public Schools. The area was annexed by the city of Albuquerque in 1993 and represents a 20 percent increase in the city's incorporated area. It is anticipated that the area will be home to as many as 40,000 households and be a major impetus for economic development for the city and the region.

Plans for Mesa del Sol call for a mixed-use pedestrian-oriented planned community with a number of districts and activity centers surrounded by large areas of open space. The community will be linked by a regional transportation, open space, and trail network, providing access to the entire metropolitan area.

For additional information, consult the 1997 Mesa del Sol Level A Community Master Plan produced by the NMSLO, Santa Fe, New Mexico (NMSLO 1997).

Future DOE Land Use on KAFB

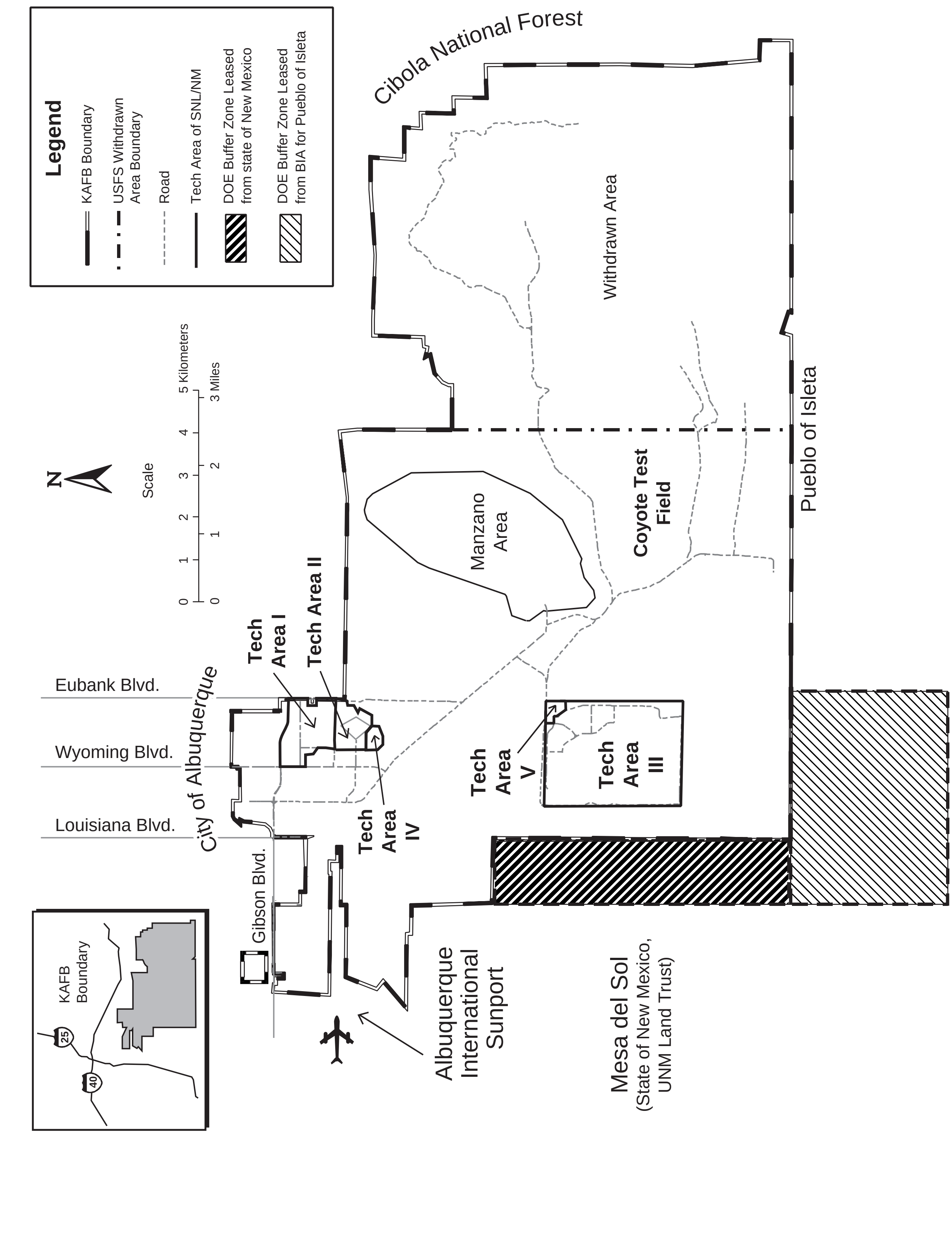
Land use on KAFB is controlled by a complicated series of agreements, permits, and leases among the DOE, the



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–6. Generalized Land Use Adjacent to KAFB

Land adjacent to KAFB has a wide variety of uses.



Sources: DOE 1993c, 1996b; SNL/NM 1997a

Figure 4.3–7. DOE Leased Buffer Zones

The DOE has leased buffer zones adjacent to the western and southern boundaries of KAFB.

USAF, and the USFS. Since June 1994, a Future Use, Logistics, and Support Working Group has been instrumental in developing future land use recommendations. The working group comprises representatives from the DOE, the U.S. Environmental Protection Agency (EPA), the New Mexico Environment Department (NMED), SNL/NM, the Lovelace Respiratory Research Institute, FM&T/NM, Ross Aviation, Inc., the TSD, the NNSI, the USAF, and the USFS.

The DOE and SNL/NM Citizens Advisory Board (CAB) was identified by the working group as the appropriate vehicle for public participation. The CAB receives information from the DOE and SNL/NM relevant to future land use issues. The CAB held its first future land use meeting in June 1995 and is currently in the process of reviewing site baseline data and preliminary future land use information. The Pueblo of Isleta and the Bernalillo County Commission have been apprised of future land use planning activities at SNL/NM and are provided with all pertinent communications and publications (SNL 1997a).

The Future Use, Logistics, and Support Working Group developed preliminary recommendations for KAFB and recognized the high probability of continued Federal use of the complex. Under these recommendations, the Federal government will maintain institutional control of the site and restrict access to it. Interim future land use recommendations by the working group include industrial/commercial and recreational uses as they relate to general cleanup levels. Refer to Section 4.5.3.3, for a discussion of the cleanup level designations. SNL/NM's primary land uses fit into a category of industrial/research park uses. These uses are consistent with the preliminary future land use scenarios presented to the CAB for DOE-owned properties (SNL 1997a, Keystone 1995).

Although SNL/NM land use will not change significantly in the foreseeable future, the DOE is negotiating two real estate transactions on behalf of SNL/NM. The first involves acquiring from the city of Albuquerque approximately 4 ac along Eubank Boulevard south of H Street in exchange for a right-of-way for the city to improve Eubank Boulevard south of Central Avenue (SNL 1997a). The other possible transaction involves renewing the lease arrangement with the NMSLO for the buffer zone west of TA-III and the KAFB boundary. The DOE and the NMSLO are establishing an arrangement that supports their mutual concerns for public safety while maintaining current testing capabilities (SNL 1997a, NMSLO 1997).

For a discussion of general future land use projects and developments in and adjacent to KAFB, see Chapter 6, Cumulative Effects Analysis.

4.3.2 Visual Resources

4.3.2.1 Definition of Resource

Visual resources encompass those aspects of an area that pertain to its appearance and to the manner in which it is viewed by people. This resource area provides a means to review the aesthetic qualities of natural landscapes and their modifications, associated perceptions and concerns of people, and the physical or visual relationships that influence the visibility of any proposed landscape modifications.

4.3.2.2 Region of Influence

The ROI is similar to that for land use (4.3.1.2). It consists of the geographic areas in and adjacent to KAFB where SNL/NM operations may influence the surrounding landscape and associated visual characteristics.

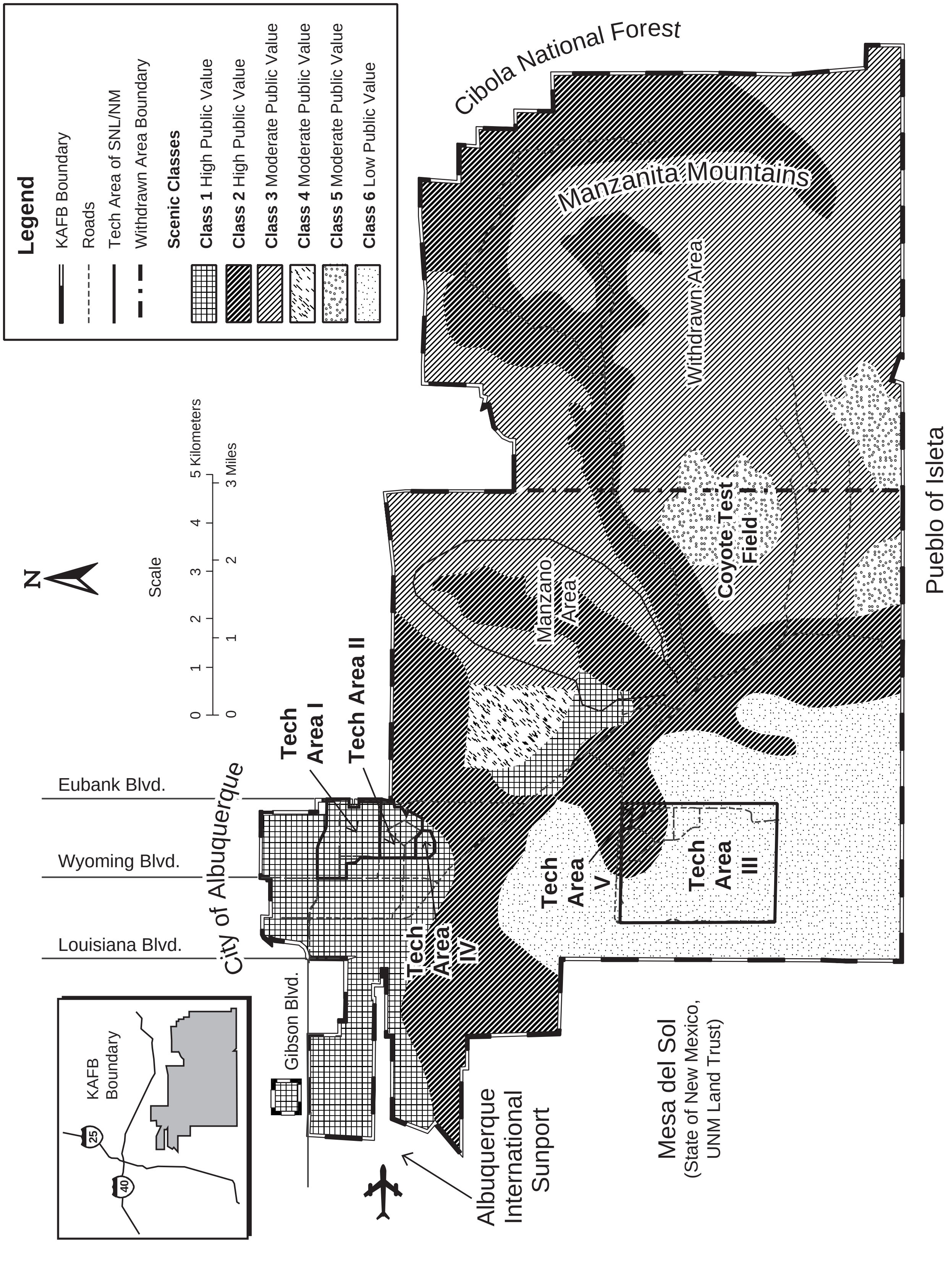
4.3.2.3 Affected Environment

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills formation and surrounding foothills of the Manzano Area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography (SNL/NM 1997a). Most SNL/NM facilities are well within the KAFB boundary and away from public view. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access. Distant views of TA-I are possible from eastbound Interstate 40, but they are brief and show limited detail. Views from Interstate 25 consist of background landscapes only (SNL/NM 1997a).

Development is the most apparent modern alteration of the natural environment on KAFB affecting visual resources. Much of this activity is striking in nature and characterized by an urban setting with large buildings, extensive roadways, utility structures, parking lots, and other developed areas. The northwestern portion of KAFB, which includes SNL/NM TAs-I, -II and -IV, is the most populated and densely developed area that exemplifies these conditions. TAs-III and -V have a more limited and scattered development pattern, but similarly exhibit a variety of man-made modifications that affect the visual environment. The Coyote Test Field and particularly the Withdrawn Area are more sparsely developed. While early construction efforts throughout KAFB may not have specifically considered surrounding visual aesthetics, resulting in discordant assemblies of buildings and associated structures, recent development by both the USAF and the DOE includes facilities with designs and materials that are more visually compatible with the natural environment. In support of goals established to improve visual resources, SNL/NM has initiated Campus Design Guidelines, which contain a set of principles and detailed design guidance that provide a framework for the physical development and redevelopment of SNL/NM sites. They include guidance for building massing, facades, color palettes, building orientation and entries, circulation corridors, standardized signage, and landscaping, including low-water-use plant selections. All new and modified facilities will be brought into compliance with these guidelines over time. These efforts have been endorsed by SNL/NM senior management and are administered through the Corporate Projects Department, the Sites Planning Department, and the Campus Development Committee (SNL 1997a).

Visual resource value ratings for aesthetics, called "scenic classes," have been developed for KAFB using the USFS Scenery Management System (Figure 4.3–8) (USFS 1995, SNL/NM 1997a). These scenic classes are based on evaluating landscape character and scenic attractiveness, as well as on the number of observers/users in the area. The latter generate concern levels that measure the degree of public importance on landscapes viewed from travelways and use areas. For the KAFB visual resource analysis, viewer input was obtained from SNL/NM personnel working throughout the area, as well as from public comments solicited during preparation of the Cibola National Forest environmental analysis (USFS 1996). The scenic classes are rated from 1 to 6, corresponding to a gradual range from highest public value (1) to lowest public value (6). The higher the public value, the more important it is to maintain the highest scenic value. This evaluation provides baseline information for assessing potential effects on scenery from proposed projects or other proposed landscape changes.

As shown in Figure 4.3–8, the majority of SNL/NM TAs and other facilities are in areas where the scenic class indicates high public value (scenic class 1 or 2). Although these locations represent areas where the landscape is not particularly distinctive and has been extensively modified by development, the scenic class is elevated by the large number of observers and users present who generate high levels of concern for scenery. On a practical level, this means that future development at SNL/NM should continue to include efforts, such as the Campus Design Guidelines described above, to improve visual resources. Remote facility locations, particularly in the southwestern corner of KAFB and most of TA-III, are in areas of lower scenic value due to a combination of reduced observer/user sensitivity levels, indistinct landscape features, and extensive development. Other areas of SNL/NM activity, such as the Coyote Test Field and the Withdrawn Area, are generally within scenic classes representing high-to-moderate public value due to the inherently distinctive, less developed, and attractive nature of the area.



Source: SNL/NM 1997a

Figure 4.3–8. KAFB Scenic Classes

The scenic classes on KAFB range from the highest public value (scenic class 1) to low public value (scenic class 6).

4.4 INFRASTRUCTURE

4.4.1 Definition of Resource

Infrastructure consists of buildings, services, maintenance, utilities, material storage, and transportation systems and corridors that support the operations of a facility. Specifically, SNL/NM's infrastructure consists of water, sanitary sewer, storm drain, steam, fossil fuels, chilled water, electrical transmission, electrical distribution, communications, roads, and parking that support TAs-I, -II, -III, -IV, and -V and other DOE facilities at KAFB (SNL 1997a). For a discussion of land use, see Section 4.3.

4.4.2 Region of Influence

The ROI for infrastructure mainly consists of assets used by SNL/NM within KAFB. KAFB includes the physical area that encompasses KAFB, lands owned by the DOE, lands owned by the USAF, and portions of the Cibola National Forest withdrawn from public entry by the USAF and the DOE.

SNL/NM relies primarily on KAFB for infrastructure support, including base security, roads, electrical distribution, water supply, and sewage. Table 4.4–1 presents information on the type of utilities and amounts used by SNL/NM and KAFB. Table 4.4–1 also identifies utility capacities.

4.4.3 Affected Environment

4.4.3.1 SNL/NM Buildings

Buildings within SNL/NM are listed by type and square footage in Table 4.4–2. Physical attributes such as construction type, gross square feet, and usage distinguish primary buildings.

4.4.3.2 SNL/NM Services and Maintenance

SNL/NM's management and operations (M&O) contractor is Lockheed Martin Corporation. Under the office of SNL/NM's President and Laboratory Director, the complex is organized into 11 divisions: Physical Sciences and Components; Weapon Systems; Human Resources; Laboratory Development; National Security Programs; Energy, Environment, and Information Technology; Laboratory Services; California Laboratory; Systems, Science, and Technology; Business, Management, and Chief Financial Officer; and Defense Programs Products and Services. Extensive descriptions of key programs and services are provided in the *SNL Sites Comprehensive Plan FY 1998-2007* (SNL 1997a).

SNL/NM has a maintenance program supported by appropriate *National Environmental Policy Act* (NEPA) review. Routine maintenance and upgrades currently underway or planned include the following:

Table 4.4–1. Utility Capacities and Quantities Used by SNL/NM and KAFB

UTILITY	USAGE				KAFB CAPACITY
	SNL/NM (1996)	% OF CAPACITY	OTHER KAFB (1996)	% OF CAPACITY	
Water	440 M gal	22.0	710 M gal	35.5	2 B gal
Wastewater	280 M gal	32.9	256 M gal	30.1	850 M gal
Electricity	197,000 MWh	18.0	307,000 MWh	28.0	1.1 M MWh[a]
Natural Gas[b]	580 M ft^3[c]	26.5	680 M ft^3	31.1	2.3 B ft^3
Fuel Oil	15,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure
Propane	370,000 gal[c]	NA	Not reported	NA	Not limited by infrastructure

Sources: DOE 1997k, SNL 1997a, SNL/NM 1997b
B: billion
ft^3: cubic foot
gal: gallon
KAFB: Kirtland Air Force Base
M: million
MWh: megawatt-hour
NA: not applicable
SNL/NM: Sandia National Laboratories/New Mexico
[a] Based on 125-megawatt (MW) rating
[b] Estimate based on 60 pounds per square inch (psi)
[c] Quantities were not typical due to several factors including weather and boiler tests at the steam plant, and were not used as baseline quantities in Chapter 3 on Table 3.6–2 and Chapter 5 on Table 5.3.2–1.

Table 4.4–2. Summary of SNL/NM Buildings and Their Square Footage

SNL/NM BUILDING TYPES	NUMBER OF BUILDINGS	GROSS SQUARE FT (GSF)	% OF GSF	PARAMETERS
Primary Buildings	125	4,441,636	88	Buildings > 3,000 GSF Permanent, semi-permanent, or wood/steel construction; not leased space
Other Buildings	304	268,319	6	Nonprimary buildings < 3,000 GSF
Mobile Offices	180	200,530	4	Mobile offices < 3,000 GSF
Transportable Buildings	65	109,529	2	Transportable buildings < 3,000 GSF
TOTAL	**674**	**5,020,014**	**100**	

Source: SNL 1997a
<: less than
>: greater than
SNL/NM: Sandia National Laboratories/New Mexico

- cleaning, painting, repairing, renovating, and servicing buildings, equipment, vehicles, and utility infrastructure;
- maintaining and extending onsite roads, parking areas, and access control structures;
- replacing, upgrading, and maintaining equipment, tools, and components, such as computers, valves, pumps, filters, monitors, and equipment controls to preserve, improve, and extend the life of the infrastructure; and
- maintaining, replacing, and upgrading environment, safety, and health equipment, controls, and monitoring capabilities.

4.4.3.1 Roadways and Transportation Access

The general road network in KAFB is shown in Figure 4.4–1. Key roads include Interstates 25 and 40. Interstate 25 runs north-south and is approximately 1.5 mi west of the KAFB boundary at its nearest approach. Interstate 40 runs east-west through Albuquerque and is approximately 1 mi north of the KAFB boundary at its nearest approach.

Access to KAFB and SNL/NM consists of an urban road network maintained by the city of Albuquerque, the gates and roadways of KAFB, and SNL/NM-maintained roads. Traffic enters SNL/NM through three principal gates: Wyoming, Gibson, and Eubank. Most commercial traffic enters through the Eubank gate because it provides direct access to the SNL/NM shipping and receiving facilities located in TA-II. An additional entrance to KAFB, the Truman gate, serves KAFB's western areas.

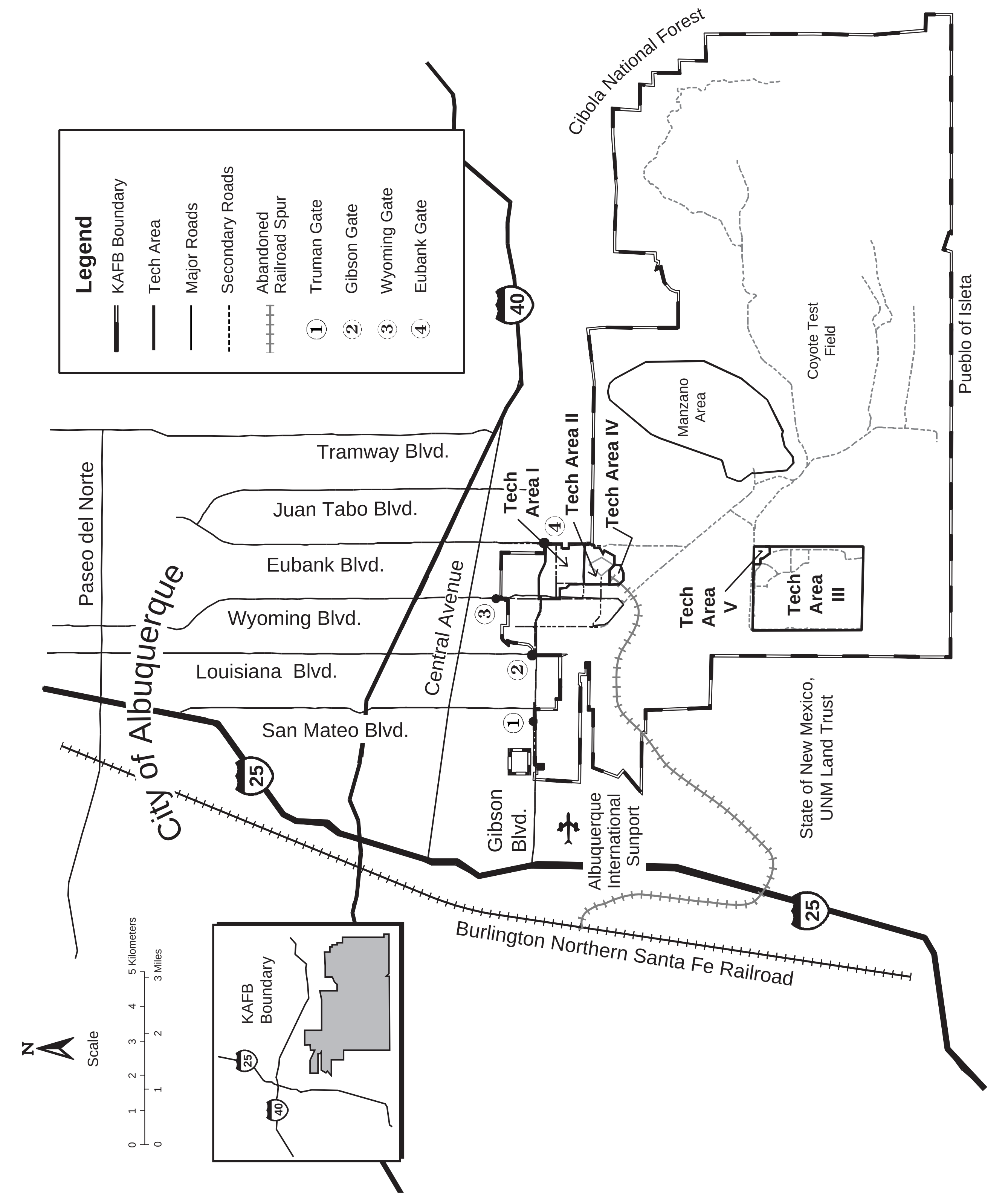
SNL/NM maintains approximately 20 mi of paved roads, 25 mi of unpaved roads, approximately 80 ac of paved service areas, and approximately 80 ac of paved parking (SNL 1997a). The roads near SNL/NM experience heavy traffic in the early morning and late afternoon. The principal contributors are SNL/NM staff and other civilian and military personnel commuting to and from KAFB. Survey estimates of employee-related traffic entering KAFB are between 10,000 to 13,500 SNL/NM and DOE commuters per day (SNL/NM 1997a). SNL/NM and DOE commuters represent approximately 36 percent of commuter traffic on KAFB (SNL 1997a). For a discussion of transportation-related issues such as traffic, see Section 4.11.

Rail facilities are not available on KAFB. The Burlington Northern & Santa Fe railroad discontinued its spur into KAFB in 1994. Land within KAFB, permitted to the DOE for the railroad right-of-way, has been returned to the USAF and demolition of the spur has begun.

Primary air service is provided for the entire region by the Albuquerque International Sunport, located immediately northwest of KAFB. Runways and other flight facilities are shared with KAFB.

4.4.3.2 Water

The water supply system consists of 85 mi of piping that, in 1996, provided 440 M gal of water (22 percent of KAFB capacity) for fire protection, industrial support of



Source: SNL/NM 1997j

Figure 4.4–1. General Area Road Network in KAFB

Access to SNL/NM consists of key roads, Interstates 25 and 40, and an urban road network maintained by the city of Albuquerque.

SNL/NM's research programs, and sanitary use (Table 4.4–1). The highest volume user is the Microelectronics Development Laboratory (MDL), which uses approximately 44 M gal of water per year for its activities. The second largest individual user (14.3 M gal per year) is the steam plant, supplying steam to SNL/NM and KAFB for space heating and laboratory processes (SNL 1998a).

KAFB owns and operates the water supply and distribution system, which includes the main booster pump station, storage reservoirs, and wells. Neither the existing water service from KAFB to SNL/NM, nor most major SNL/NM facilities are metered. The minimum pipeline size is dictated by the need for fire protection; sanitary and industrial use determine the size of service lines to specific facilities. For a discussion of water resources, see Section 4.6.

4.4.3.3 Sanitary Sewer

In 1996, the sewer system consisted of a 40-mi underground pipe network that discharged approximately 280 M gal per year (32.9 percent of KAFB capacity) of industrial and domestic wastewater (Table 4.4–1). Wastewater has leaked from underground sewer lines. Possible soil contamination associated with these leaks is being investigated and cleaned up as part of the SNL/NM Environmental Restoration (ER) Project. Sections 4.5 and 4.6 discuss ER Project activities.

4.4.3.4 Storm Drain

As part of its storm drain system, SNL/NM maintains approximately 15 mi of pipe and 2 mi of channel. KAFB experiences periodic thunderstorms accompanied by brief periods of intense rainfall. Approximately one-half of the system is designed to provide a means of storm water control to protect buildings, roads, and equipment from a 100-year storm event. The remaining half, which does not meet the current standard, has been assessed and upgrades, modifications, and repairs are currently underway in order to effectively control storm water throughout the facility and meet the 100-year storm event criteria. Existing drainage channels require continuous maintenance to correct erosion problems and remove weeds, sediment, and debris that inhibit proper flow (SNL 1997a).

4.4.3.5 Electrical Transmission and Distribution

SNL/NM maintains approximately 115 mi of electrical transmission/distribution lines. The electrical transmission system is a high-voltage (46-kV) overhead transmission system from the Public Service Company of New Mexico (PNM) to the various substations within SNL/NM. SNL/NM maintains the 26 master unit substations that distribute all its electrical power. The estimated monthly electric bill for the DOE, KAFB, and SNL/NM is $1.6 M. PNM provides power to SNL/NM through the Eubank substation, located east of SNL/NM. A second source of power from PNM is currently under construction south of TA-IV (SNL 1997a).

South of Tijeras Arroyo, KAFB owns and maintains the transmission lines that support SNL/NM facilities. The system has experienced outages to facilities in TAs-III, -IV, and -V and the Coyote Test Field. Improvements to the system are anticipated pending completion of an upgrade project (SNL 1997a). In 1996, SNL/NM used 197,000 MWh (18 percent of KAFB capacity) (Table 4.4–1).

4.4.3.6 Natural Gas

SNL/NM maintains 4.5 mi of gas line. Natural gas supplied by PNM is the primary heating fuel used at the steam plant. It is also supplied to self-contained boilers at facilities in TAs -I, -II, and -IV, which are not on the steam distribution system. Laboratories also use natural gas in many of the buildings for heating and experiments. SNL/NM uses approximately 580 M ft^3 per year (26.5 percent of system capacity). Diesel fuel is used as an emergency backup during natural gas pressure interruptions. SNL/NM uses 370,000 gal of propane per year in TAs-III and -V and in other remote locations (SNL 1997a). Natural gas and propane use in 1996 was not considered typical due to several factors, including weather and tests associated with the steam plant. However, the recent completion of a natural gas line into the area is expected to significantly reduce the demand for propane, while increasing use of natural gas.

The source of natural gas to KAFB and the SNL/NM central steam plant is a high-pressure line that enters KAFB near the intersection of Pennsylvania Avenue and Gibson Boulevard. The reliability of the line may be questionable, since it has been damaged in the past. Two low-pressure gas isolation valves allow restoration of service if the primary distribution line becomes damaged. The internal low-pressure gas system is a dual loop throughout the TAs that provides a backup source if a portion of the line becomes temporarily disabled. This distribution system is made of steel pipe and requires protection to prevent corrosion. Recent projects have upgraded the steel pipelines, replaced building gas valves, and replaced many of the steel lines with polyethylene pipe, thus eliminating the need for previously required protection measures (SNL 1997a).

4.4.3.7 Steam/Chilled Water

The purpose of the steam system is to provide heat for buildings and hot water for sanitary use. It is also used to provide humidity in a limited number of buildings and chilled water through absorption chillers. The steam plant supplies an average of 1.5 M lbs per day of saturated steam for space heating in TA-I and the eastern portion of KAFB (SNL/NM 1997b). SNL/NM maintains 14 mi of piping for steam and 1 mi of piping for chilled water.

4.4.3.8 Communications

SNL/NM maintains 2,900 mi of communication lines. Surveys indicate that the system may be nearing capacity; however, system upgrades are meeting the current demand for data links (SNL 1997a).

4.4.3.9 Selected Infrastructure Facilities

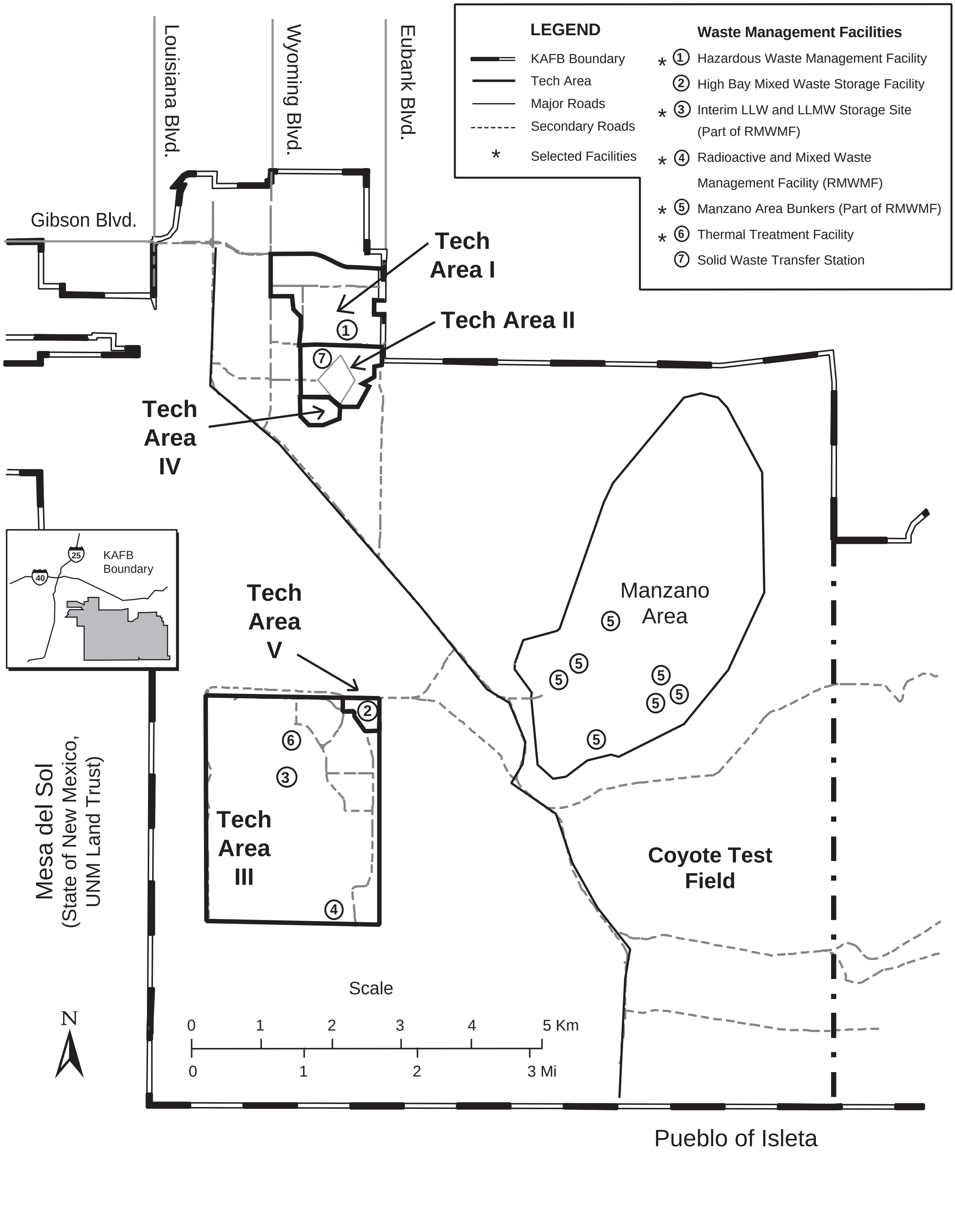
The steam plant, Radioactive and Mixed Waste Management Facility (RMWMF), Thermal Treatment Facility (TTF), and Hazardous Waste Management Facility (HWMF) were identified as representative facilities that provide infrastructure support services. For a discussion of the facility screening process, see Section 2.3. Steam plant functions are discussed in the Facility Descriptions that follow Chapter 2.

The three remaining facilities are waste management facilities. The facilities vary in size, capacity, and scope of operation, depending on the waste type for which they are designed. SNL/NM manages low-level waste (LLW,) low-level mixed waste (LLMW), transuranic (TRU) waste, mixed transuranic (MTRU) waste, and hazardous waste. Descriptions of these wastes and associated management facilities are provided in Section 4.12. Figure 4.4–2 shows the locations of the three selected waste management facilities and four additional waste management facilities on SNL/NM.

4.4.3.10 Material Storage and Inventory

SNL/NM stores and manages a wide variety of hazardous and nonhazardous materials. Hazardous materials include radioactive materials; chemicals including solvents, acids, bases, and specialty gases; explosives and explosive containing materials; and fuels. Nonhazardous materials include plastics, metals, certain solvents, certain oils like mineral oil, and simple office materials like paper. For a detailed discussion of SNL/NM material management see *SNL/NM Environmental Information Document* (SNL/NM 1997a).

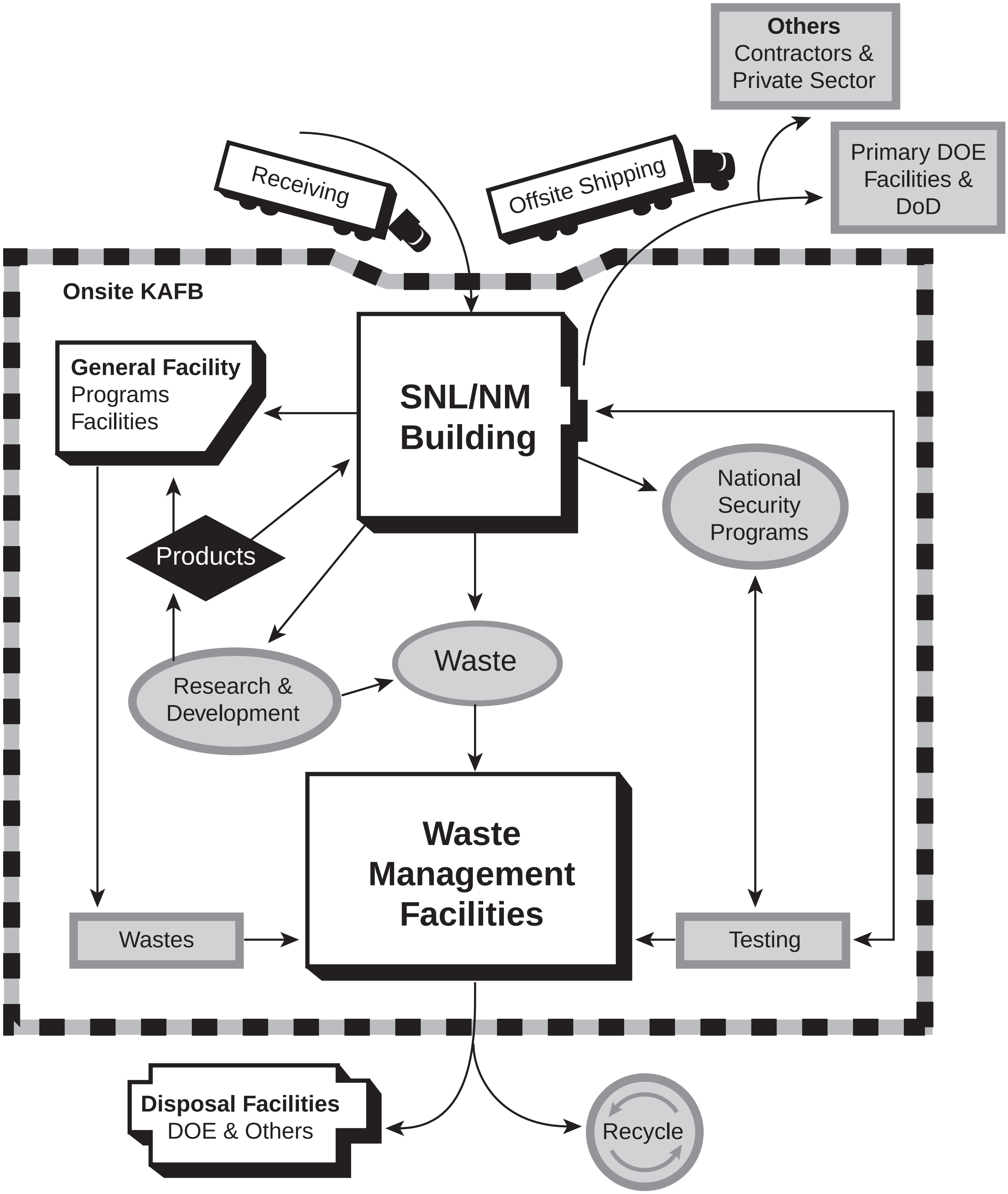
Figure 4.4–3 illustrates conceptually how materials move at SNL/NM. For details regarding material inventories used for analysis in the SWEIS, see Appendix A. The material inventories and SNL/NM databases were used to analyze potential air quality impacts, human health impacts including accidents, and transportation requirements (see Sections 4.9, 4.10, and 4.11, respectively).



Source: SNL/NM 1997j, 1998ee

Figure 4.4–2. Waste Management Facilities

SNL/NM manages a variety of waste through seven facilities located throughout SNL/NM.



Source: SNL/NM 1997j

Figure 4.4-3. Conceptual Illustration of Material Movement at SNL/NM

SNL/NM receives materials that are then distributed to testing, research and development, and other facilities.

4.5 GEOLOGY AND SOILS

4.5.1 Definition of Resource

The discussion of geology and soils includes seismology, slope stability, and soil contamination. Seismology refers to the geology below the soil layer that is relevant to the occurrence, frequency, and magnitude of earthquakes. Slope stability generally focuses on the stability of the soil layer. For the purpose of this SWEIS, soils include natural material at the ground surface extending to a depth that construction activities could reasonably disturb (20 to 30 ft).

4.5.2 Region of Influence

The main concern of seismic activity and slope stability is their effect on onsite facilities, specifically, whether damage from earthquakes or slope failures could result in a contaminant release. The ROI would, therefore, be the extent of environmental or human health effects from such a release. Offsite impacts from these and other accidental releases are addressed in Sections 5.3.8.2, 5.4.8.2, and 5.5.8.2.

Potential soil contamination effects would result from exposure at or near the contaminated area. Thus, the ROI is limited to KAFB. Potential migration of soil contaminants into groundwater or surface water is addressed in Sections 4.6.1.3 and 4.6.2.3.

4.5.3 Affected Environment

4.5.3.1 Seismology

SNL/NM straddles the eastern boundary of the 30-mi-wide Albuquerque-Belen Basin, about midway along its north-south trending length of about 90 mi (Figure 4.5–1). The city of Albuquerque is in a region expected to experience moderate earthquakes that could result in damage to buildings, depending on the quality of construction (SNL/NM 1997a). Since 1966, New Mexico has experienced four moderate earthquakes, all approximately 5.0 on the Richter scale. Two of these were in Dulce (near the Colorado border in north-central New Mexico), one was in Gallup (near the Arizona border in west-central New Mexico), and one was in Eunice (extreme southeast corner of New Mexico, near the Texas border). The Dulce and Gallup earthquakes were the closest to SNL/NM, all approximately 125 mi away. The largest shock predicted in New Mexico in a 100-year period would have a magnitude of 6.0 on the Richter scale (SNL/NM 1997a). The Richter scale does not measure damage. Damage is dependent upon several factors, including duration of the event, type of movement, facility design, and construction materials and practices.

A number of regional faults (Sandia, West Sandia, Manzano, Hubbell Springs, Tijeras, and Coyote) intersect within KAFB (Figure 4.5–2). There is no evidence of movement along these faults over the last 10,000 years (SNL/NM 1997a).

In the Albuquerque area, the largest magnitude earthquake of the century, a recorded magnitude 4.7 on the Richter scale, occurred on January 4, 1971. SNL/NM buildings did not receive any appreciable damage. A survey after the event noted cracks in some SNL/NM buildings, but the cracks could have predated the earthquake (SNL/NM 1997a).

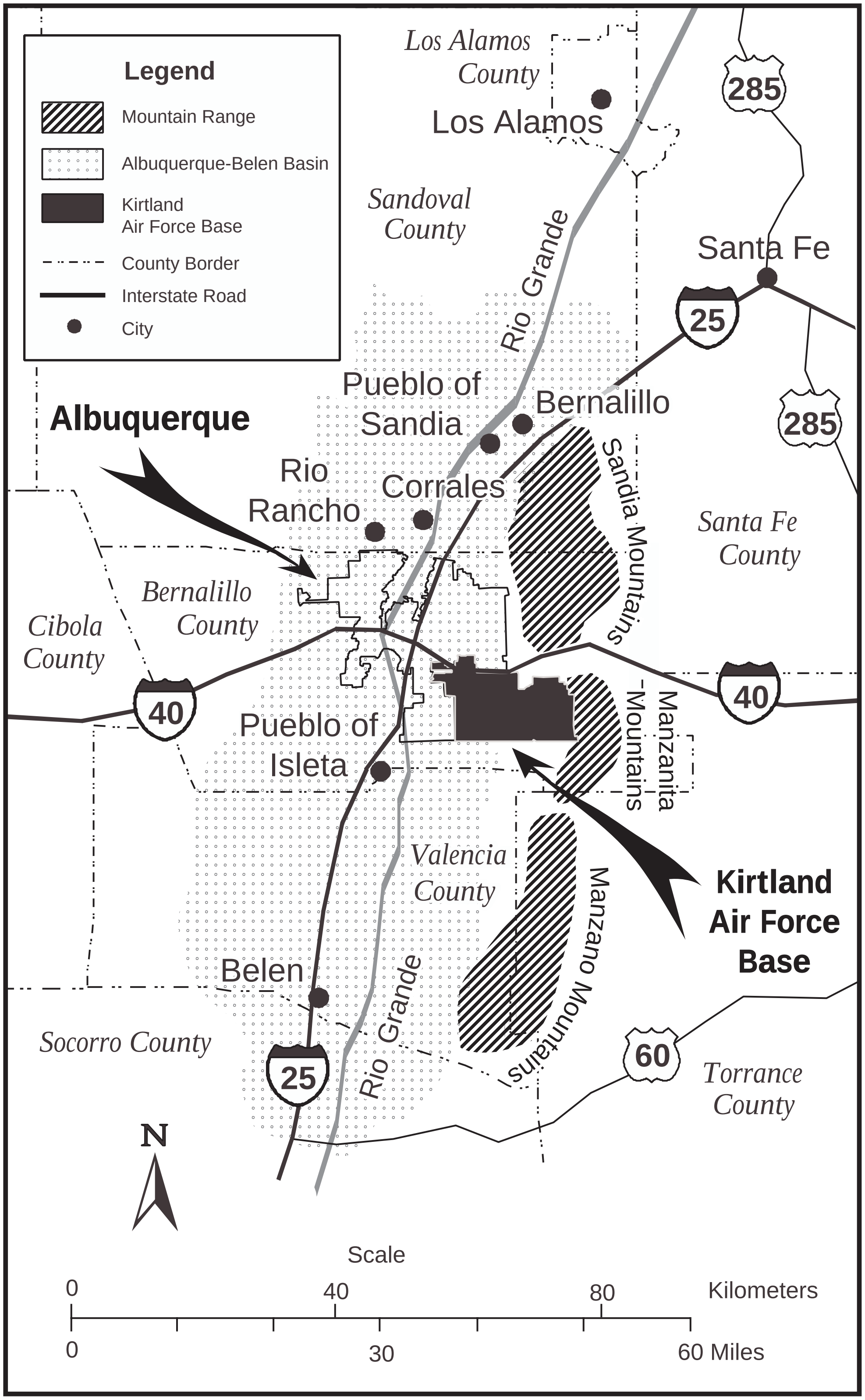
4.5.3.2 Slope Stability

Most SNL/NM facilities are constructed on level ground or gentle slopes. These areas are composed of alluvial fan sediments that slope westward toward the Rio Grande. Steeper slopes occur along the arroyos (particularly where channel erosion occurs during periods of storm runoff) and in the Manzanita Mountains. Facilities near slopes are those that border the Tijeras Arroyo at the southern edge of TA-IV, including Building 970 and parking areas, and the ECF, Building 905, in TA-II. Similarly, there are only two SNL/NM facilities in the Manzanita Mountains—the Lurance Canyon Burn Site and the Aerial Cable Facility. The Manzanita Mountains are predominantly Precambrian crystalline and Paleozoic marine carbonate bedrock and are not prone to landslides. To date, no SNL/NM facility has been affected by slope instability.

4.5.3.3 Soil Contamination

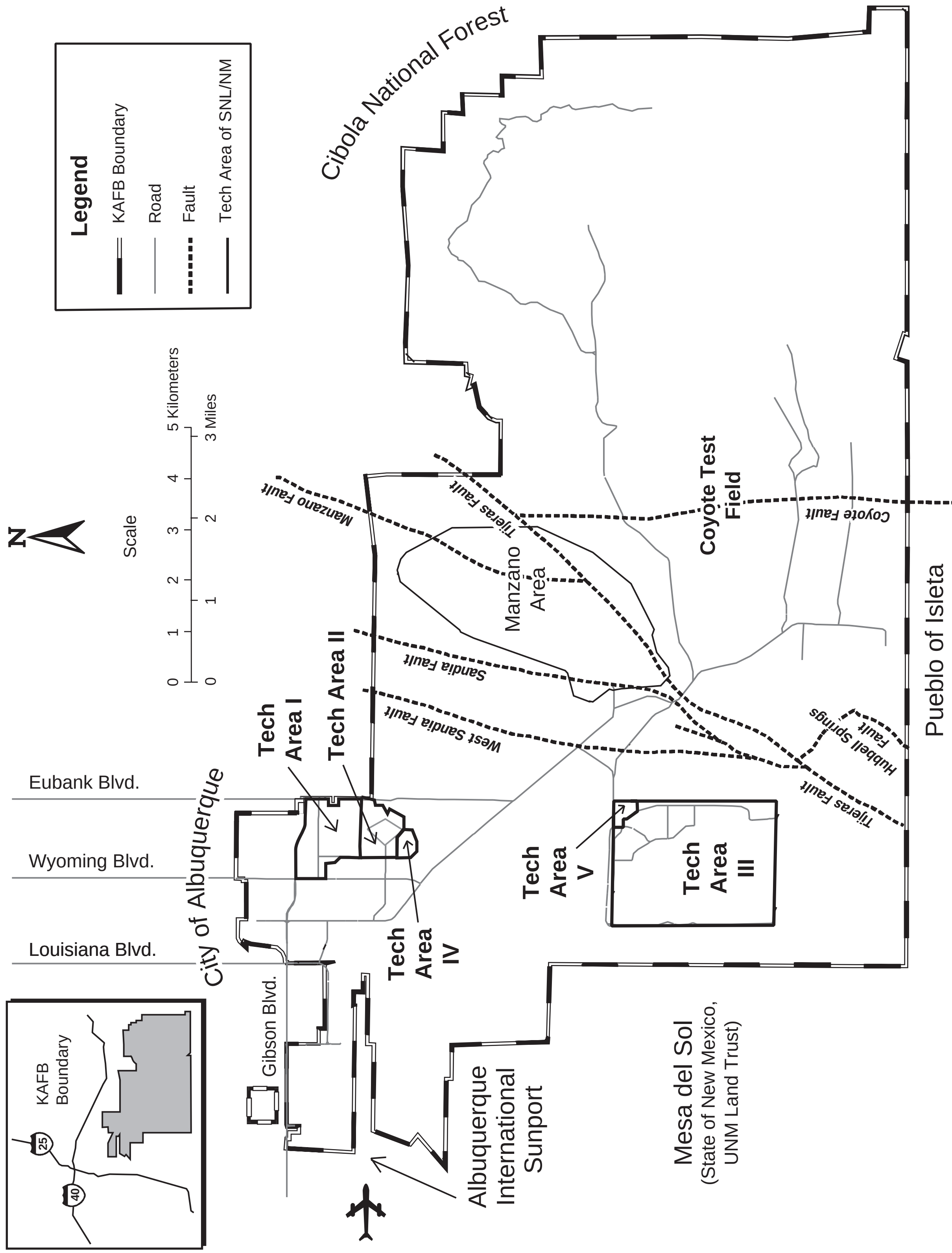
Soils at SNL/NM are derived primarily from eroded bedrock in the Manzanita Mountains that was transported downslope by water. Soil layers formed by these sediments tend to be discontinuous. The chemical composition of these soils reflect the composition of the source bedrock, and soils at SNL/NM frequently have high naturally occurring (background) concentrations of the metals arsenic, beryllium, and manganese (SNL/NM 1996e).

As a result of past SNL/NM activities, soil contamination exists or may exist at a number of locations at KAFB, although most sites are less than 1 ac in size



Sources: SNL/NM 1997j, USGS 1995

Figure 4.5–1. Location and Extent of the Albuquerque-Belen Basin
SNL/NM is located along the eastern edge of the Albuquerque-Belen Basin.



Sources: SNL/NM 1997a, 1997j

Figure 4.5–2. Regional Faults at KAFB

Six regional faults intersect KAFB.

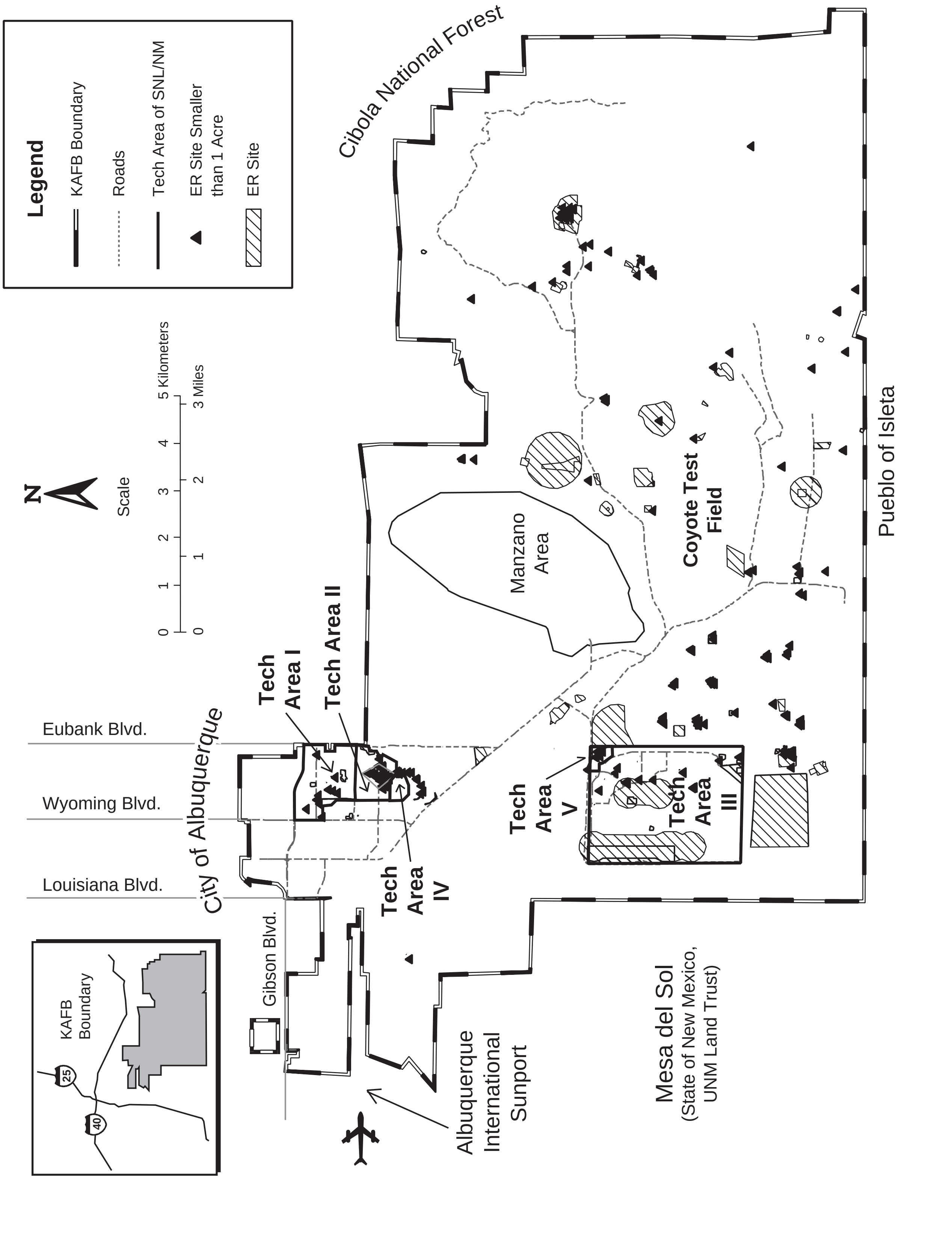
(Figure 4.5–3). Cleanup of these contaminated sites is regulated under RCRA. SNL/NM investigates and remediates these sites through the ER Project. Under the ER Project, potentially contaminated sites go through an investigative process that includes identification, sampling, and, if necessary, remediation. SNL/NM proposes no further action at sites that do not have contamination or that have concentrations of contaminants that pose no appreciable risk to human health or the environment. The state of New Mexico has the authority to approve or reject "no further action" proposals. As of August 1998, 182 sites had been identified, with 122 proposed as "no further action" to the NMED

Further, of the 182 sites identified under the ER Project, 47 are within 0.5 mi of a major surface water drainage, either Tijeras Arroyo or Arroyo del Coyote (DOE 1996c). Of these, 39 were proposed by SNL/NM for no further action, either because confirmatory soil sampling failed to show the presence of contamination or contaminants in soil were present in low concentrations.

Sites that pose a potential risk to human health and the environment will undergo some type of remediation, often the removal of contaminated soil. Some residual contamination may remain at these sites, but at concentrations presenting little or no human-health risk. Immediate risks to human health are addressed through short-term measures, such as restricting site access or covering contaminated soil with tarps or commercially available dust suppression products that reduce the chance of airborne soil particles (DOE 1996c). Monitoring near ER Project sites indicates that exposure to dust particles is not a significant transport pathway for radioisotopes (Section 4.1) (SNL 1996a). The ER Project is scheduled for completion between Fiscal Year (FY) 2003 and FY 2005.

Soil contamination also exists at some active SNL/NM outdoor test facilities. In the past decade, environmental controls on testing have reduced the concentrations or extent of additional soil contamination. The ER Project addresses soil contamination resulting from past testing (DOE 1996c). Most of the soil contamination at these active sites is shallow surface contamination stemming from the explosion, destruction, or burning of tested devices containing hazardous material. The primary contaminants at these active sites are depleted uranium (DU) and lead.

SNL/NM actively performs environmental soil monitoring on and near KAFB to confirm the effectiveness of control systems in place at the various TAs. Soil samples are collected twice annually from 50 locations: 31 onsite, 13 at the site perimeter, and 6 offsite (SNL 1997d). Samples are analyzed for common radionuclides and metals, with analytical results compared to naturally occurring concentrations. For 1996, most soil monitoring results showed no difference from naturally occurring concentrations. However, three onsite locations had higher-than-background soil concentrations of tritium (averaging 20.13 pCi/ml versus 0.24 pCi/ml offsite), which were associated with identified ER Project sites in controlled areas (SNL 1996a, 1997d). Excluding these three locations, onsite tritium concentrations averaged 0.72 pCi/ml (SNL 1997d).



Source: SNL/NM 1997j

Figure 4.5–3. Locations of SNL/NM Environmental Restoration Sites

One hundred eighty-two sites have been identified for investigation and potential remediation under the SNL/NM Environmental Restoration Project.

4.6 WATER RESOURCES AND HYDROLOGY

4.6.1 Groundwater

4.6.1.1 Definition of Resource

Groundwater in the KAFB area occurs within saturated unconsolidated geologic material and fractured and porous bedrock. Aquifers are subsurface layers of rock or unconsolidated material that are capable of yielding usable amounts of water to wells or springs.

4.6.1.2 Region of Influence

The groundwater beneath the western portion of KAFB is part of an interconnected series of water-bearing geologic units within the Albuquerque Basin that form the Albuquerque-Belen Basin aquifer (Figure 4.5–1). Groundwater beneath the eastern portion of KAFB occurs in limited quantities in fractured bedrock. The Albuquerque-Belen Basin aquifer and the bedrock aquifer in the eastern portion of KAFB define the ROI.

4.6.1.3 Affected Environment

The principal sedimentary fill of the Albuquerque-Belen Basin is the Santa Fe Group, consisting of gravels, sands, silts, and clays (Figure 4.6–1). The local (SNL/NM area) groundwater system has three hydrogeologic regions (HRs), which are delineated by their locations in relation to the geologic fault system that bisects KAFB (Figure 4.6–2).

HR-1, within which the SNL/NM TAs are located, is to the west of the fault system. It consists of thick unconsolidated sedimentary deposits overlying bedrock. The Albuquerque-Belen Basin aquifer occurs in this unit of unconsolidated sediments and is the source of Albuquerque's municipal water. Groundwater flow is generally north to northwest in the northwestern portion of KAFB where TAs-I, -II, and -IV are located (Figure 4.6–2). Hydraulic conductivities range from less than 0.1 ft to more than 100 ft per day. The depth of the unsaturated zone, from ground surface to the aquifer, increases toward the west and is approximately 500 ft at the western edge of KAFB.

HR-2 straddles the Sandia/Tijeras/Hubbell Springs fault system. This region is a transition between the unconsolidated sedimentary character of HR-1 and the bedrock-dominated character of HR-3. Hydraulic conductivities are highly variable, ranging from 0.003 ft per day in bedrock to near 150 ft per day in alluvial material. Depth to groundwater is also highly variable, ranging from 500 ft near the southeast corner of TA-III to near zero ft along the Arroyo del Coyote south of the Manzano Area (Figure 4.6–2). The eastern portion of KAFB, which includes the Coyote Test Field and the Withdrawn Area, is within HR-2 and HR-3.

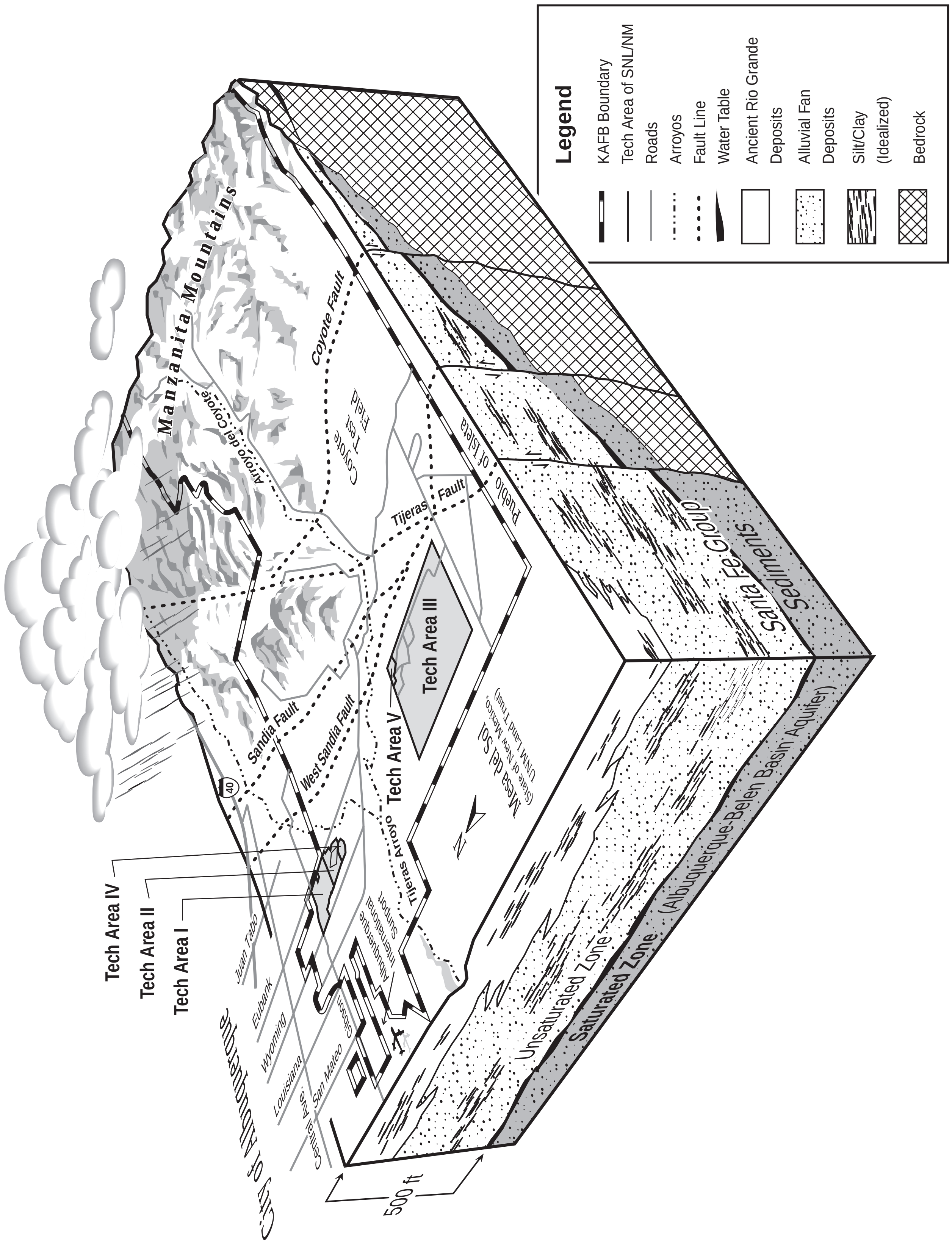
HR-3 is characterized by its bedrock aquifers, although in some places a thin layer of groundwater-containing alluvial material overlies the bedrock. Depth to groundwater in HR-3 varies from 150 ft near the Hubbell Springs Fault to near zero ft along portions of Arroyo del Coyote (SNL/NM 1997a). The depth to groundwater may exceed 150 ft in mountainous areas, but data are limited.

Groundwater Quality

A network of monitoring wells is used to collect samples for characterizing baseline water chemistry and groundwater contamination (Figure 4.6–3). This network is part of an active environmental monitoring program covering groundwater, surface water, and air (SNL 1995c, 1996a).

The groundwater beneath SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, and adjacent portions of the city of Albuquerque and the Pueblo of Isleta. The local groundwater is also used for irrigation and industry. Federal and state water quality standards are based on the type of water use (for example, drinking, irrigation, or recreation). Maximum contaminant levels (MCLs) are based on the National Primary Drinking Water Regulations. The New Mexico Water Quality Control Commission (NMWQCC) has established maximum allowable concentrations for some substances for which no Federal MCLs have been established (NMWQCC 1994).

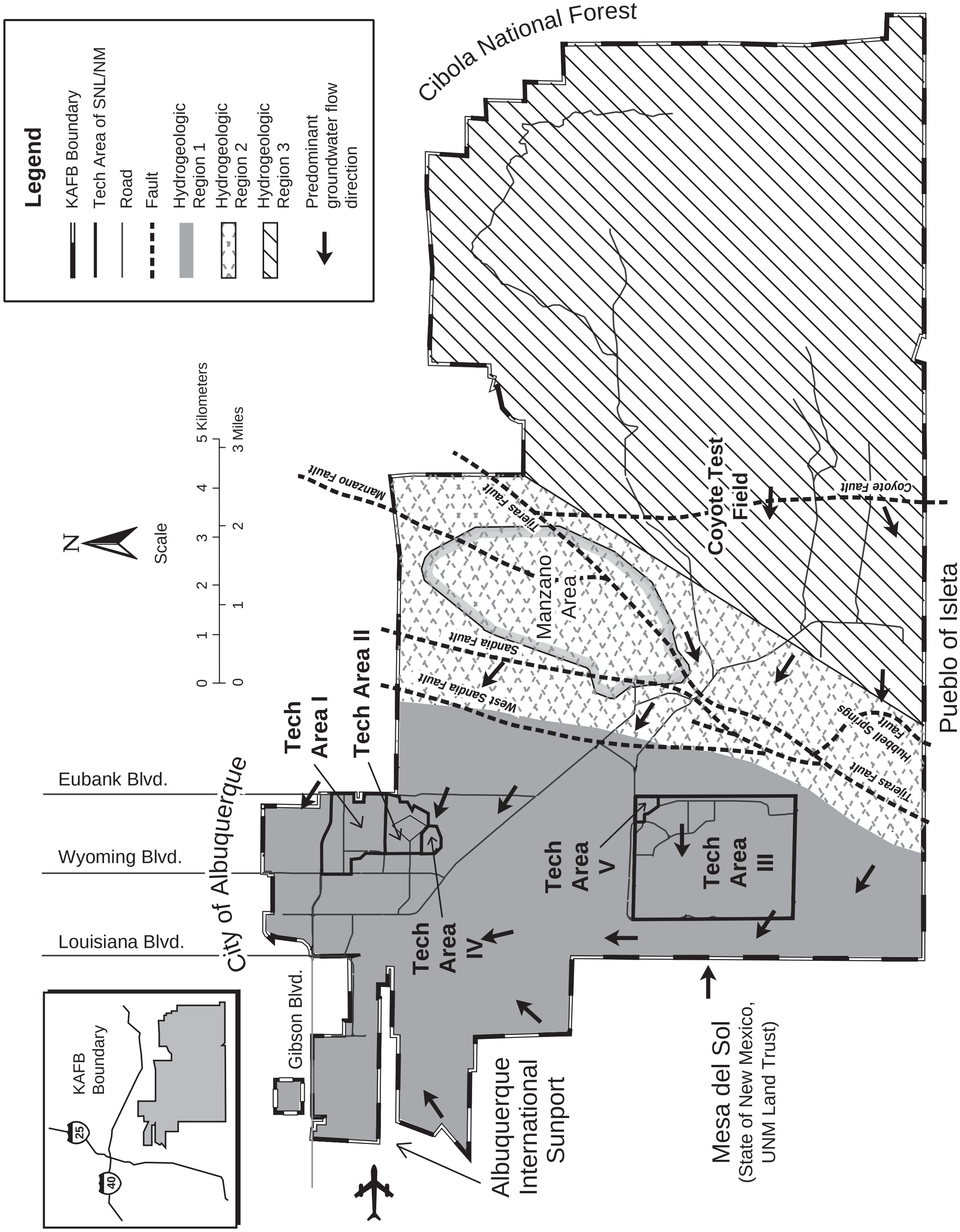
Groundwater quality can be influenced by the presence of contaminants in the soil column above the groundwater, as well as in the groundwater itself. These influences are of major concern to the SNL/NM ER Project, which is investigating the nature and extent of groundwater contamination from past activities at SNL/NM sites. All known groundwater contamination is the result of past waste management activities that occurred before the enactment of such laws as the *Resource Conservation and Recovery Act* (RCRA), the *Toxic Substances Control Act* (TSCA), and the *Clean Water Act* (CWA).



Source: Original

Figure 4.6–1. Conceptual Diagram of Groundwater System Underlying KAFB

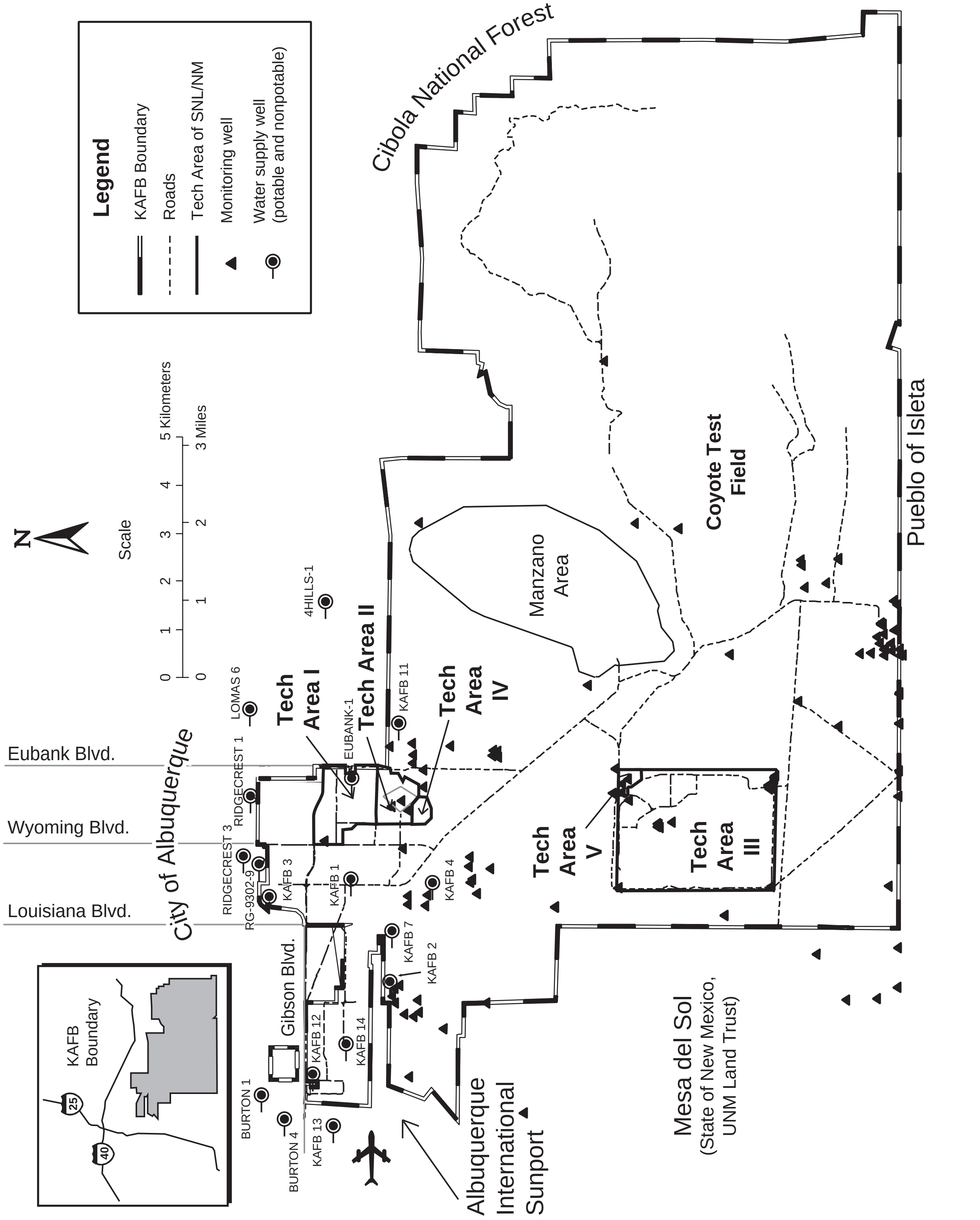
Santa Fe Group alluvial sediments and groundwater underlie KAFB.



Source: SNL/NM 1997j

Figure 4.6–2. Locations of Hydrogeologic Regions at KAFB

The SNL/NM area groundwater system has three hydrogeologic regions.



Source: SNL/NM 1997j

Figure 4.6–3. Locations of Groundwater Monitoring and Supply Wells

A network of monitoring wells is used to collect samples for environmental monitoring.

Locations of Potential or Known Groundwater Contamination

Sites with potential or known groundwater contamination at SNL/NM are Sandia North (an ER Project designation for groundwater investigations of sites in TA-I and TA-II), the Mixed Waste Landfill (MWL), locations in TA-V, Lurance Canyon Burn Site, and the Chemical Waste Landfill (CWL) (SNL 1997d) (Figure 4.6–4). Measurements indicate that some contaminants at some of these sites exceed MCLs (40 *Code of Federal Regulations* [CFR] Part 141) (Table 4.6–1). Investigation or remediation of these sites is ongoing as part of the ER Project.

Sandia North

Sandia North is a 1.2-mi^2 area located in the northern part of KAFB. It encompasses TA-I and TA-II and includes approximately 40 environmental restoration sites. Underlying the Sandia North area are shallow, perched (not connected with the regional Albuquerque-Belen Basin aquifer) water-bearing zones, with a gradient toward the southeast, and deep regional groundwater (approximately 500 ft deep) that flows generally to the northwest and north. Some city of Albuquerque and KAFB production wells are located within 1 mi of the Sandia North area. Trichloroethene (TCE) and nitrates have been detected in both the deep and shallow groundwater beneath the Sandia North area. Since 1993, six shallow and three deep wells have been used to monitor groundwater in the Sandia North area. TCE and nitrates have been detected repeatedly in some of these wells. TCE has been detected at nearly three times the MCL in a deep aquifer monitoring well; nitrate has been detected at nearly three times the MCL in a shallow monitoring well (Table 4.6–1).

An investigation plan is being implemented to characterize the sources and site hydrogeology (SNL/NM 1998bb). The sources of the TCE and nitrate have not been determined. Possible explanations include multiple sources among the SNL/NM environmental restoration sites located in this area or nearby private landfills not associated with SNL/NM.

Mixed Waste Landfill

The MWL was established in 1959 for the disposal of radioactive and mixed wastes. The landfill, inactive since 1988, is located in the north-central part of TA-III and encompasses approximately 2.6 ac. Uranium, thorium, transuranics, fission products, and tritium were disposed of in the landfill. Tritium has been detected in soils below and outside the perimeter of the MWL.

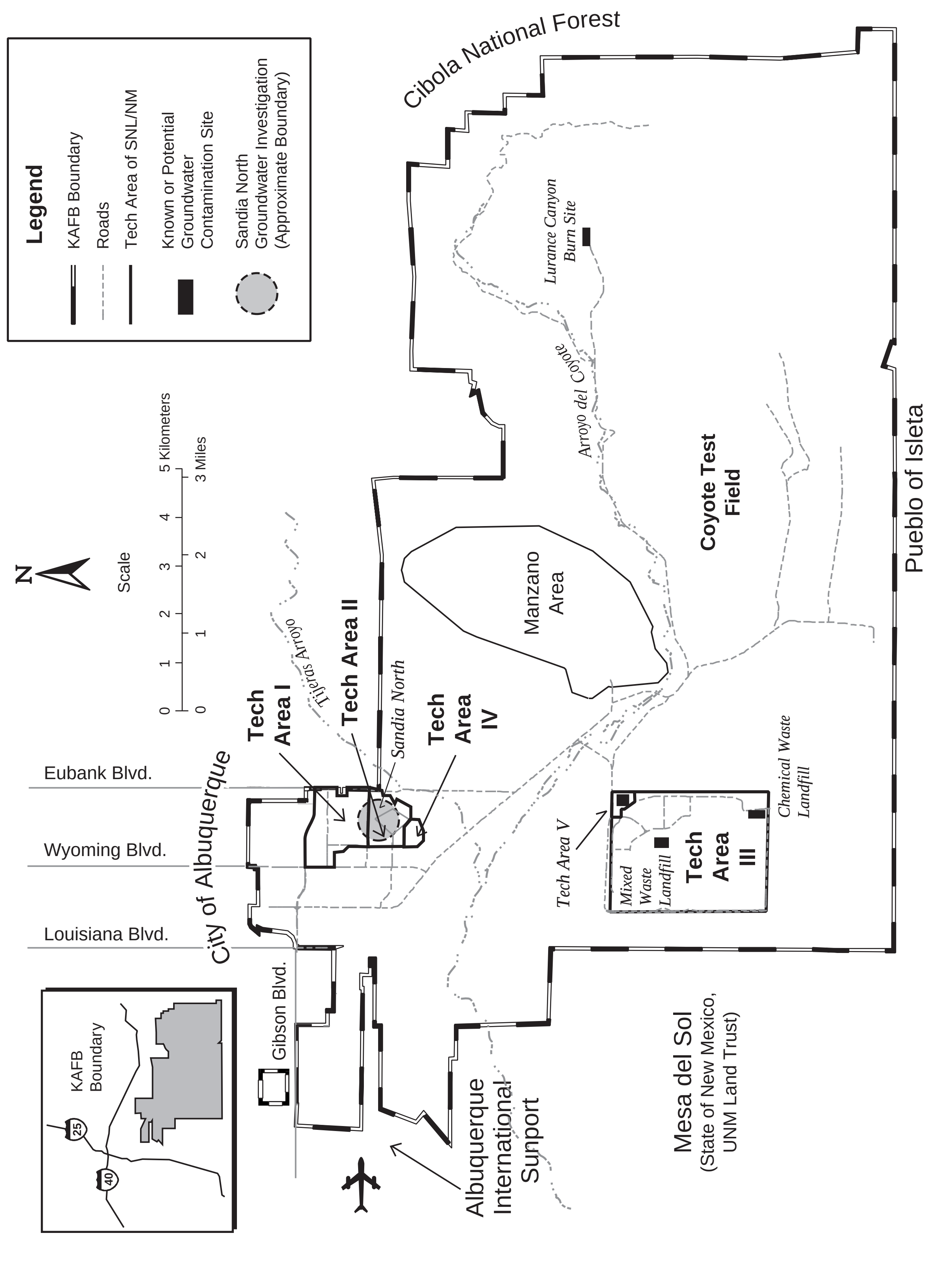
The regional water table at the MWL occurs at a depth of approximately 460 ft. No evidence of groundwater contamination has been detected at the landfill since September 1990 in 21 rounds of sampling. Nickel has been measured in one monitoring well at a concentration (0.145 mg/L) above the 0.1-mg/L MCL. The concentrations of nickel in groundwater samples at this well are attributed to dissolution of the stainless-steel well screen (SNL 1997d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996), with these concentrations confined to water within or immediately surrounding the well (not characteristic of concentrations in the aquifer). Monitoring of nickel concentrations continues at this location. SNL/NM has removed broken and subsided concrete caps at the MWL to reduce the possibility of ponding water infiltrating underlying wastes. The waste pits where the concrete caps were removed were backfilled with soil to ground surface to promote precipitation runoff. Site remediation is projected to be completed in 2001.

TA-V

The TA-V area contains nine monitoring wells, including those that monitor the Liquid Waste Disposal System (LWDS) site. During 1996, TCE was present at levels of about 3 to 4 times the 0.005-mg/L MCL at one LWDS well. TCE has been detected in several wells at concentrations below the MCL. It is believed that the TCE is reaching groundwater via aqueous phase transport. The likely source of the TCE is approximately 6.4 M gal of wastewater released to the LWDS drainfield from 1963 to 1967. In 1996, nitrate concentrations as high as 12 mg/L (versus an MCL of 10 mg/L) were found in samples at two wells, including the LWDS well (SNL 1997d). The probable sources of the nitrates are septic tanks and leachfields; these systems have been closed and waste and contamination from these sites have been removed.

Lurance Canyon Burn Site

The Lurance Canyon Burn Site is located in the eastern part of KAFB in a canyon in the Manzanita Mountains. This site was used in the 1970s for testing high explosives. Today it is used to test the effects of fire on weapons components and equipment. Nitrates have been consistently found in a production well used to supply fire-control water to the Burn Site, at concentrations



Sources: SNL 1997d, SNL/NM 1997j

Figure 4.6–4. SNL/NM Known or Potential Groundwater Contamination Sites

Sites with potential for or that have known groundwater contamination are located at TAs-I, -II, -III, and -V and the Coyote Test Field.

Table 4.6–1. Maximum Recorded Levels of Suspected Groundwater Contamination at SNL/NM

SITE	CONTAMINANTS	MAX MEASURED CONCENTRATIONS	MCL
Sandia North (TA-I and TA-II)	TCE	0.014 mg/L	0.005 mg/L
	Nitrate[a]	29 mg/L	10 mg/L
TA-V	TCE	0.023 mg/L	0.005 mg/L
	Nitrate[a]	13.1 mg/L	10 mg/L
Chemical Waste Landfill	TCE	0.026 mg/L	0.005 mg/L
Lurance Canyon Burn Site	Ethylbenzene	0.0037 mg/L	0.750 mg/L
	Toluene	0.055 mg/L	0.750 mg/L
	Xylenes (total)	0.019 mg/L	0.620 mg/L

Sources: 40 CFR Part 141; DOE 1996c; SNL 1997d; SNL/NM 1996z, 1998hh
MCL: maximum contaminant level
mg/L: milligram per liter
TA: technical area
TCE: trichloroethene
[a] All nitrate concentrations are as nitrogen.

ranging from 8 to 27 mg/L, near or above the 10-mg/L MCL (SNL 1997d). A recently installed downgradient monitoring well shows the presence of nitrates and low levels (below MCLs) of toluene, ethylbenzene, and xylenes, which are components of petroleum hydrocarbons. An ongoing investigation will identify the sources of nitrates and other contaminants.

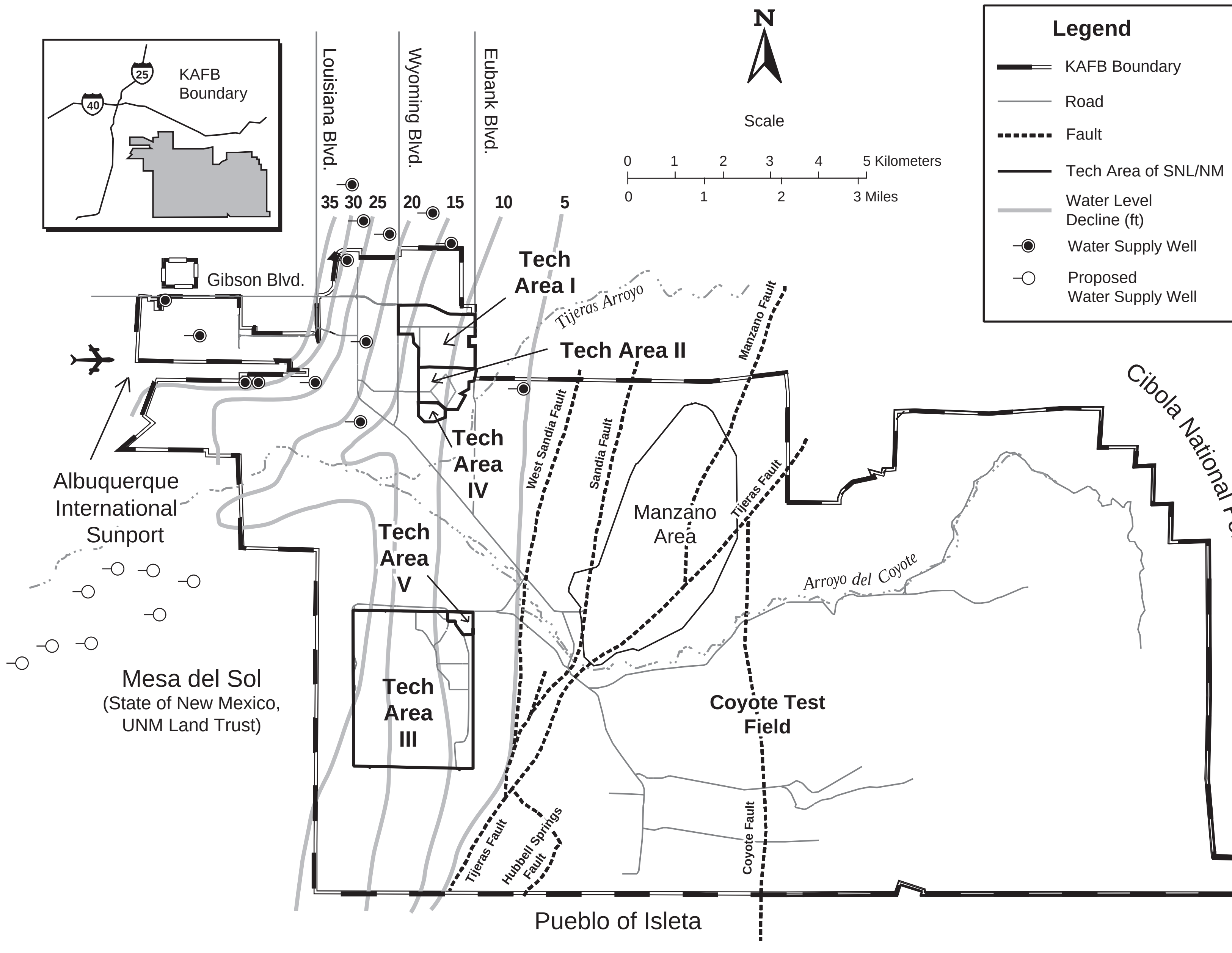
Chemical Waste Landfill

The CWL, located in TA-III, is currently managed in accordance with the *Chemical Waste Landfill Closure Plan* (DOE 1992d) that was approved in 1993 by the NMED. Although cleanup is underway at the CWL, there is no plan to remove the entire source (DOE 1996c). The primary inorganic and organic contaminants of concern at the CWL are hexavalent chromium (disposed of as chromic acid) and TCE, respectively (DOE 1992d). TCE has been discovered in the groundwater beneath the site at levels above the EPA's drinking water standard of 0.005 mg/L (SNL 1997d). The released chromium has not reached the water table, although chromium is found in groundwater samples as a result of stainless-steel corrosion from the monitoring wells that were installed in 1988 (SNL/NM 1995d). Such dissolution is a well-known phenomenon (Hewitt 1992, Oakley and Korte 1996). Furthermore, if the chromium in the aquifer were a result of vertical transport of the CWL contamination, chromium contamination would be continuously seen in the vadose zone down to the water table. Chromium contamination is not found in the lower 410 ft of the vadose zone.

Groundwater Quantity

Little moisture is available for groundwater recharge from direct precipitation on the site. Recharge estimates range from 0.004 to 0.1 inch per year. Local groundwater recharge is associated primarily with infiltration of arroyo water during short-term storm events. Water supply wells (in the Santa Fe Group) for the city of Albuquerque and KAFB are near the northern boundary of KAFB (Figure 4.6–3). Pumping from these wells and others throughout the Albuquerque-Belen Basin results in groundwater withdrawal exceeding recharge. The 1996 KAFB withdrawal was 1.16 B gal; some of the nearby city well fields pump considerably more than this amount (SNL/NM 1997a).

An excess of withdrawal over recharge results in a continuing decline in groundwater levels beneath the site. In HR-1, groundwater levels have been declining at rates of 0.2 to 3.0 ft per year. During the 12-year period from 1985 through 1996, water levels declined by more than 35 ft in the extreme northwestern portion of KAFB (Figure 4.6–5). At KAFB, the rates of drawdown are greatest westward from the fault zone and northward near the water-supply wells. Water levels in HR-2 and HR-3 have not been affected by water supply production in HR-1 (SNL/NM 1997a).



Sources: SNL/NM 1997a, 1997j; NMSLO 1997

Figure 4.6–5. Decline in Water Levels from 1985 through 1996

During the period from 1985 through 1996, groundwater levels in parts of KAFB declined by more than 35 ft.

A shallow groundwater system underlies TA-II and TA-IV at approximately 300 ft below the ground surface. Groundwater within this system perches on a relatively impermeable layer of sediments above the Albuquerque-Belen Basin aquifer. Relatively shallow groundwater also underlies the Tijeras Arroyo Golf Course, about 1.5 mi east of TA-II. Water levels in this area are rising at a rate of 2 ft per year, most likely because of golf course watering. Existing information is insufficient to determine whether this shallow zone is connected to the regional Albuquerque-Belen Basin aquifer (SNL/NM 1997a).

Water level declines in the Albuquerque-Belen Basin as a whole mirror those in HR-1. Estimates of basin-wide declines range from 20 to 160 ft since the 1960s, when significant increases in groundwater withdrawal began (SNL/NM 1997a).

4.6.2 Surface Water

4.6.2.1 Definition of Resource

The surface water system on KAFB is a reflection of the dry high-desert climate of the area. Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms (July through September). With the exception of flow from two springs, there are no perennial streams or other surface water bodies at KAFB. As an example of how infrequently water flows in the arroyos, flow was detected at the lowermost Tijeras Arroyo monitoring station on only
28 days during the 4-year period from 1992 through 1995. Floodplains occur next to the major arroyos; however, their areas are small in comparison to the size of KAFB (Figure 4.6–6). Wetlands are present only in the immediate vicinity of several springs in the Manzanita Mountains.

4.6.2.2 Region of Influence

The ROI for surface water is onsite arroyos and the watershed downstream from KAFB, which consists of Tijeras Arroyo, extending from the western KAFB boundary to the Rio Grande, and the Rio Grande downstream from Tijeras Arroyo. Surface water flowing in arroyos and subject to SNL/NM influences can affect KAFB and downstream resources and users. Surface water in Tijeras Arroyo flows through public and private lands west of KAFB before discharging into the Rio Grande.

4.6.2.3 Affected Environment

Major Arroyos

The major surface drainages at SNL/NM are Tijeras Arroyo and Arroyo del Coyote (Figure 4.6–6). With the exception of two short sections of channel with intermittent flow (fed by springs), these drainages flow only during storm events.

Tijeras Arroyo is the primary drainage feature on KAFB. Above the point where Tijeras Arroyo enters KAFB, it drains approximately 80 mi^2; at the point where it exits, the drainage area encompasses approximately 122 mi^2. Tijeras Arroyo is the only substantial outlet for surface water exiting KAFB; this arroyo joins the Rio Grande 4.7 mi downstream of the KAFB boundary.

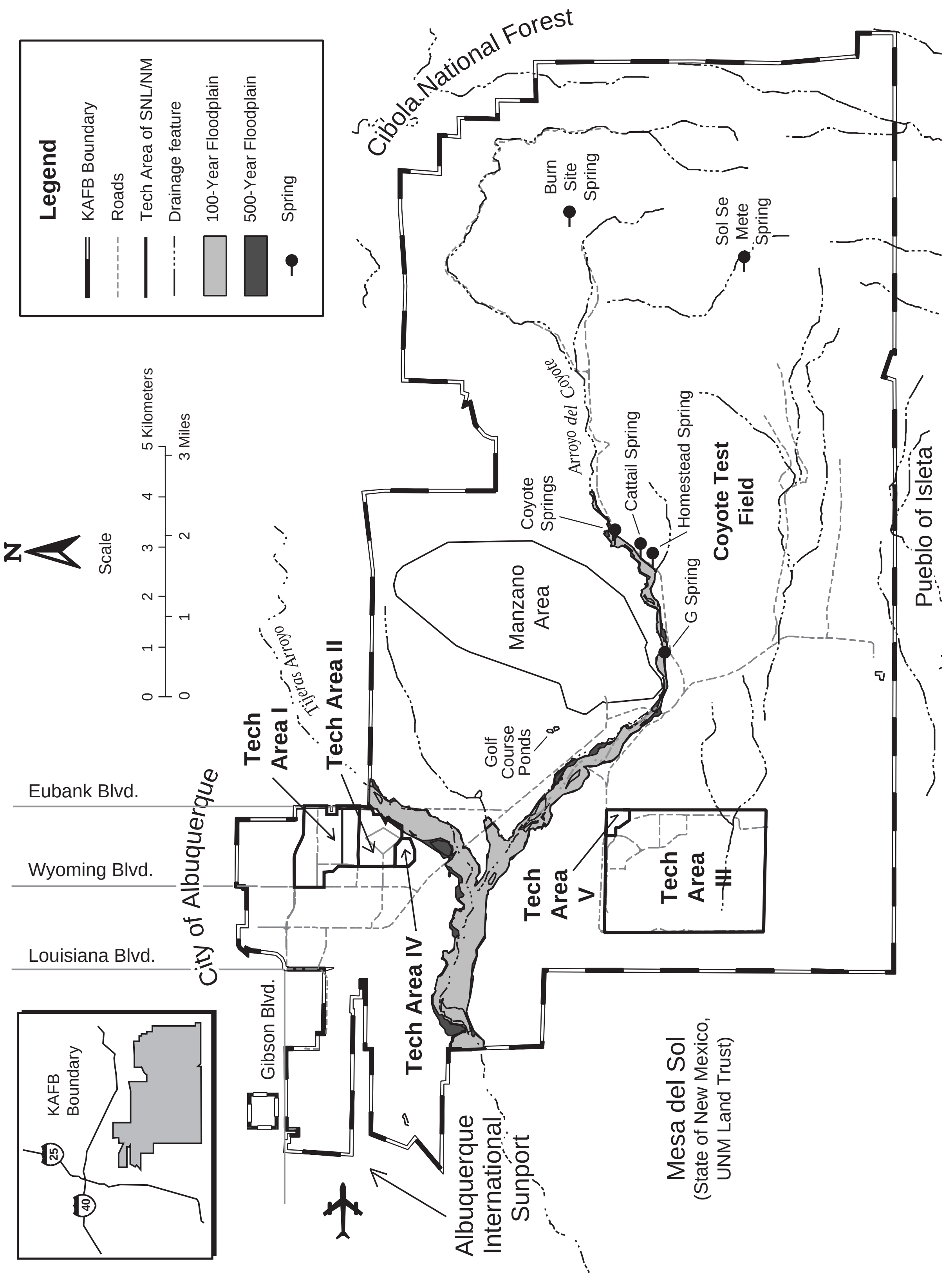
Arroyo del Coyote joins Tijeras Arroyo approximately 2 mi upstream of where Tijeras Arroyo leaves KAFB, and drains approximately 39 mi^2.

Several unnamed arroyos and drainages to the south of Arroyo del Coyote dissipate as the topographic relief decreases to the west. Storm water in this area either evaporates or infiltrates into the soil; therefore, there is no hydrologic surface connection from these areas to Tijeras Arroyo or the Rio Grande.

Floodplains and Wetlands

Floods and runoff occur most commonly during the summer thunderstorm season (July through September) when approximately 50 percent of the average annual rainfall occurs. Snow in the Manzanita Mountains can produce local runoff that rarely reaches the lower portions of the arroyos or the Rio Grande. Figure 4.6–6 shows the 100- and 500-year floodplains. Note that 100-year floodplains identified in TA-I (DOE 1996c) are not shown on Figure 4.6–6. These are narrow floodplains confined to existing drainage channels and several low-lying streets and vacant areas.

Wetlands on KAFB are associated with several springs, all within the Arroyo del Coyote drainage (Figure 4.6–6). Two of these springs, Coyote Springs and Sol Se Mete Spring, flow year-round. G-Spring, Burn Site Spring, Cattail Spring, and Homestead Spring are intermittent (SNL 1997d). The water originating at springs on KAFB travels only a short distance before infiltrating the soil. Associated wetlands (if any) are smaller than 1 ac (Section 4.7.3.2). Only the Burn Site Spring is under SNL/NM control.



Source: SNL/NM 1997j

Figure 4.6–6. Arroyos, Floodplains, and Springs at KAFB

Surface water flows through several major and many small unnamed arroyos, primarily during summer thunderstorms.

No floodplain/wetlands impacts were identified for the SWEIS for which a floodplain/wetlands assessment is required under 10 CFR Part 1022.

Surface Water Quality – Storm Water Runoff

Water flowing in arroyos is subject to the quality standards listed in 20 New Mexico Administrative Code (NMAC) 6.1, *State of New Mexico Standards for Interstate and Intrastate Streams* (NMWQCC 1994). This regulation includes a set of general standards, applicable to all surface water in the state (including ephemeral streams) and additional or more stringent standards for designated bodies of water. They include criteria within the KAFB boundary for stream bottom deposits; floating solids, oil, and grease; color; odor and taste of fish; plant nutrients; toxic substances; radioactivity; pathogens; temperature; turbidity; salinity; and dissolved gases. For "nonclassified" waters, such as the arroyos on KAFB, livestock watering and wildlife habitat standards apply. Livestock watering standards are generally the most stringent, with numeric standards for 12 metals, radium-226/-228, tritium, and gross alpha.

New Mexico standards also apply to the Rio Grande from the Alameda Bridge (14 mi upstream of the Albuquerque sewage treatment plant) to the headwaters of Elephant Butte Reservoir (120 mi downstream of Tijeras Arroyo). The designated uses of this water are irrigation, limited warm water fishery, livestock watering, wildlife habitat, and secondary contact. Additional water quality criteria cover pH, temperature, fecal coliform bacteria, total dissolved solids, sulfate, and chloride.

The Rio Grande flows through the Pueblo of Isleta, beginning 6 mi downstream from the confluence with Tijeras Arroyo. The Pueblo of Isleta has designated surface water quality standards (Isleta Pueblo 1992) that parallel the New Mexico standards for many quality indicators. However, Pueblo of Isleta standards are generally more specific (quantitative measures rather than qualitative criteria for oil and grease, color, plant nutrients, and turbidity) and stricter (for example, a fecal coliform limit of 100 colonies/100 ml versus 1,000 colonies/100 ml). The stricter criteria stem from additional designated uses of the Rio Grande, which are "primary contact" and "primary contact-ceremonial."

SNL/NM's discharge to arroyos is limited to runoff during storm events. Storm water from TAs-I, -II, and -IV is collected in storm sewer systems that discharge to Tijeras Arroyo. There is no discharge from TAs-III and -V because of evaporation and infiltration of storm water into the air and ground.

Potential Sources of Runoff Contamination

Environmental Restoration Project Sites

A few ER sites are located adjacent to arroyos. In July 1997, a heavy storm washed DU into the soil outside the boundary of an ER site. (This event was documented in the Occurrence Reporting and Processing System [ORPS] Report number ALO-KO-SNL-6000-1997-0006 and reported to the state [SNL 1997a].) However, past sampling activities have not shown clear evidence of contamination in local surface runoff water. Samples taken from SNL/NM operational sites in the upper Arroyo del Coyote showed higher levels of aluminum, magnesium, and copper compared to samples taken upstream of the sites, but none of these constituents has been associated with SNL/NM activities or ER sites in the area (SNL 1995c).

Permitted Storm Water Discharge

SNL/NM monitors storm water runoff from TAs-I, -II, and -IV for compliance with National Pollutant Discharge Elimination System (NPDES) permits. Sampling conducted in 1995 and 1996 show four exceedances of the New Mexico Maximum Allowable Concentrations (MACs). Manganese was detected above the 0.2-mg/L MAC on three occasions (twice at 0.24 mg/L, and once at 0.57 mg/L). Barium was detected above the 1.0-mg/L MAC on one occasion (1.1 mg/L); this concentration may be naturally occurring. No exceedances of radionuclides, organics, or other metals were detected. The concentrations of manganese noted are likely the result of high natural concentrations in KAFB soils (SNL/NM 1996e).

Storm water monitoring results from 1997 show exceedances of iron and zinc at both NPDES monitoring stations (SNL 1998e). Iron was detected at 23.7 and 12.9 mg/L, which exceeds the 1.0 mg/L MAC. Zinc was detected at 0.191 and 0.271 mg/L, which exceeds the 0.065 MAC. Total suspended solids also exceeded the permit limit of 100 mg/L, with detected concentrations of 1,660 and 1,170 mg/L. An inspection of the areas monitored by these NPDES stations found no potential sources of iron or zinc (SNL 1998e). Low flow at the NPDES monitoring stations requires placement of the sample intake tube on the bottom of the drainage channel. This likely has caused introduction of a greater amount of suspended solids than is representative of the runoff. During laboratory analysis of these samples, minerals naturally present in the suspended solids, such as iron and zinc, may appear at higher concentrations as well. SNL/NM continues to monitor runoff at these stations in accordance with permit requirements, with results reported to regulatory authorities.

Outdoor Testing Facilities

Radioactive materials could be released to the ground during outdoor testing activities conducted in TA-III and the Coyote Test Field (SNL/NM 1998a). Only facilities in the Coyote Test Field have a defined surface water drainage path to Tijeras Arroyo. SNL/NM sampling in Tijeras Arroyo has shown only trace amounts of the sampled radionuclides, uranium-233/234, -235, and -238; thorium-228, -230, and -232; and strontium-90 (Appendix B). These concentrations are consistent with estimates of background levels for surface water (SNL/NM 1996g).

Surface Water Monitoring Data

During storm events in 1994 and 1995, SNL/NM collected 32 surface water samples from onsite arroyos (Figure 4.6–7, Table 4.6–2). Not all samples were analyzed for all constituents. Most constituents of concern, which include dissolved metals, explosives, and radionuclides, were found only at trace concentrations (SNL/NM 1996g). Only aluminum was detected above applicable standards in any of the samples (5 of 29 samples analyzed). Three of these samples, including the sample with the highest aluminum concentration (41.4 mg/L), were collected from tributaries of the Arroyo del Coyote in the Withdrawn Area. These sampling locations are upstream of SNL/NM facilities, indicating that aluminum at these concentrations is naturally occurring.

Surface Water Quality - Wastewater

SNL/NM discharges both sanitary and industrial effluents into the Albuquerque sanitary sewer system. Sanitary effluents include wastewater from restrooms and cafeterias and from other domestic activities. Industrial discharges originate from laboratory processes, general manufacturing, and experimental activities. SNL/NM actively monitors compliance with discharge permits (see Section 7.3.4.1) and policies that allow no direct disposal of hazardous chemicals or radioactive materials into the sewer system.

As part of the wastewater management program, SNL/NM also maintains a small number of septic systems (at remote facilities) that are periodically pumped and discharged by certified pumping contractors. Contents are sampled before pumping to ensure that the sewage meets regulatory criteria. SNL/NM submits wastewater permit applications, which detail potential pollutant sources and the raw materials used in industrial processes, to the city of Albuquerque. To ensure compliance with the discharge limits stated on each city permit, SNL/NM conducts monthly sampling at each general outfall monitoring station and continuous monitoring of pH and water flow at all permitted stations.

During 1996, SNL/NM reported two permit violations for all wastewater discharges (both pH exceedances lasted a total of 4.5 hrs). No violations were reported for 1995 (SNL 1996a).

Surface Water Quantity

The quantity of surface water flow depends on the nature of both the drainage area (soil characteristics, slope, and vegetation) and the storm event (intensity and duration). Flow data for the arroyos is limited; only one stream gauge was in place before 1994.

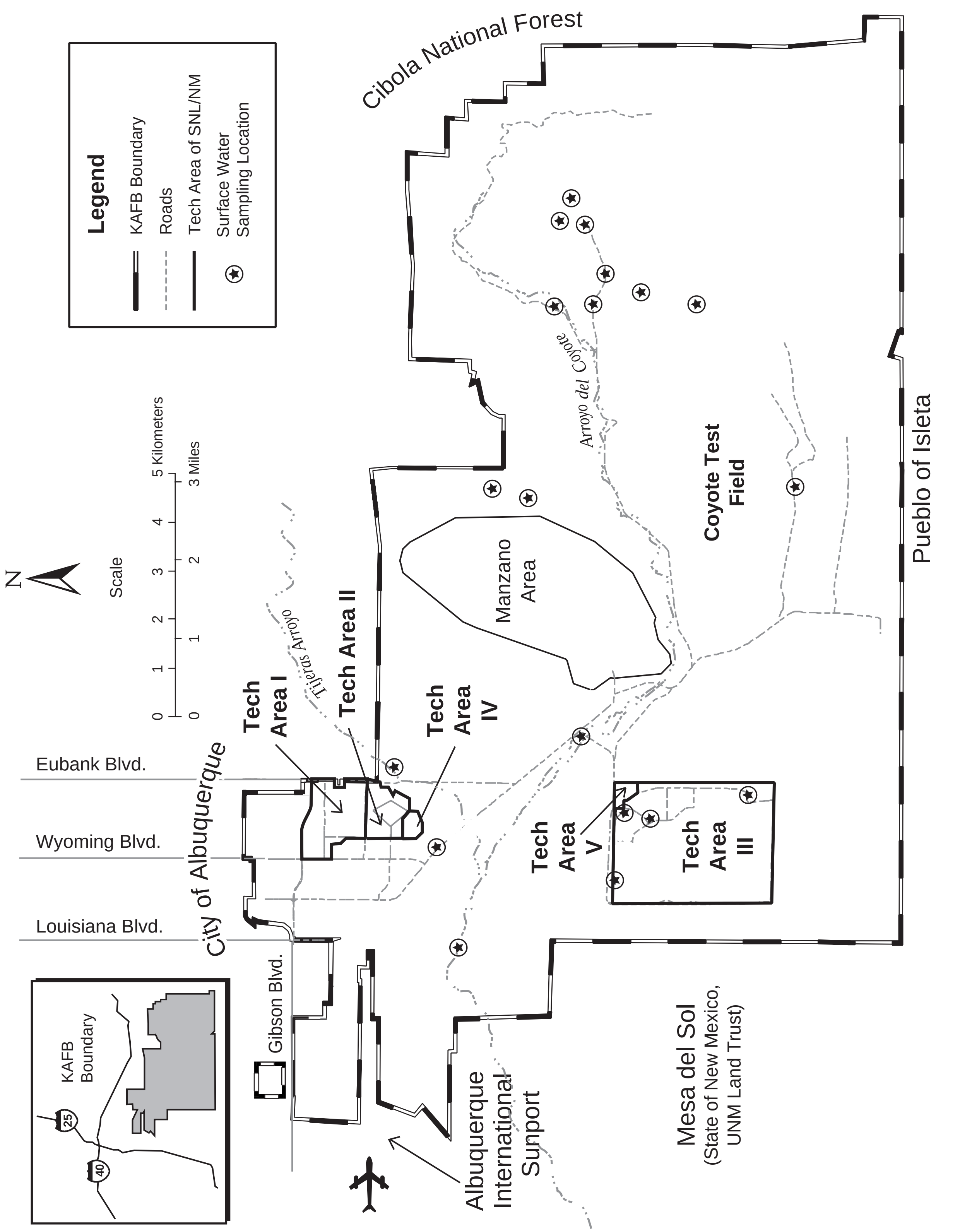
SNL/NM activities affect surface water quantity in two ways: storm water runoff from SNL/NM facilities and discharge of process and sanitary water to the Albuquerque sewage treatment plant.

Storm Water Runoff

Parking lots, buildings, and other activities that have altered the natural vegetation or topography have affected the quantity of storm water runoff. Increases in the amount of storm water runoff from SNL/NM activities are due to the replacement of natural surfaces (soil and desert vegetation) with more impervious surfaces (primarily buildings and parking lots). Runoff to arroyos is more likely to occur from impervious surfaces, either directly or through storm sewers. The greatest areal extent of paved surfaces and buildings is in TA-I, which contains the densest population of SNL/NM employees.

Discharge to Sanitary Sewer

SNL/NM discharges approximately 770,000 gal of water per day to the sanitary sewer, the result of manufacturing activities and sanitary water used in SNL/NM facilities (SNL/NM 1997a). This water flows to the Albuquerque sewage treatment plant, where it is treated along with other sewage from the city. The treated water is discharged to the Rio Grande, about 0.7 mi north of Tijeras Arroyo. The discharged water must meet Federal and state quality standards.



Sources: SNL 1995c; SNL/NM 1997j

Figure 4.6–7. Locations of Surface Water Samples Collected During 1994 and 1995

Thirty-two surface water samples were collected from nineteen locations at KAFB during 1994 and 1995.

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
METALS (mg/L)							
Silver	29	2	ND	0.0061	0.00485	0.00485	NA
Aluminum	29	21	ND	41.4	4.93	1.7	5.0
Arsenic	29	1	ND	0.016	0.016	0.016	0.2
Barium	29	20	ND	3.9	0.53	0.22	NA
Beryllium	29	3	ND	0.0091	0.0062	0.0056	NA
Calcium	29	18	ND	1,690	205	51.65	NA
Cadmium	29	1	ND	0.0056	0.0056	0.0056	0.05
Cobalt	29	8	ND	0.021	0.0096	0.0084	1.0
Chromium	29	0	NA	NA	NA	NA	1.0
Copper	29	16	ND	0.096	0.022	0.0135	0.5
Iron	29	19	ND	23.2	2.21	0.82	NA
Mercury	29	3	ND	0.0003	0.00019	0.00016	0.01
Potassium	18	17	ND	14.9	4.94	4.3	NA
Magnesium	29	26	ND	20.4	4.44	3.5	NA
Manganese	29	18	ND	2.6	0.54	0.27	NA
Sodium	19	10	ND	11.3	3.28	2.6	NA
Nickel	29	10	ND	0.054	0.019	0.00965	NA
Lead	29	15	ND	0.04	0.015	0.011	0.1
Antimony	29	0	NA	NA	NA	NA	NA
Selenium	29	3	ND	0.012	0.0076	0.0057	0.05
Tin	10	0	NA	NA	NA	NA	NA
Thallium	29	3	ND	0.011	0.0086	0.011	NA
Vanadium	29	19	ND	0.081	0.024	0.016	0.1
Zinc	28	18	ND	0.24	0.087	0.059	25.0
EXPLOSIVES (μg/L)							
1, 3-DNB	16	0	ND	ND	NA	NA	NA
HMX	16	0	ND	ND	NA	NA	NA
Nitrobenzene	16	0	ND	ND	NA	NA	NA
RDX	16	0	ND	ND	NA	NA	NA

Table 4.6–2. Summary of Surface Water Quality Data Collected by the Site-Wide Hydrogeologic Characterization Project (1994 and 1995) (concluded)

ANALYTE	SAMPLES ANALYZED	NUMBER OF DETECTIONS	MINIMUM	MAXIMUM	MEAN DETECT	MEDIAN DETECT	STANDARD[a]
EXPLOSIVES ($\mu g/L$)							
Tetryl	16	2	ND	1.9	1.25	1.25	NA
2,6-DNT	16	0	NA	NA	NA	NA	NA
2,4-DNT	15	0	NA	NA	NA	NA	NA
2,4,6-TNT	16	2	ND	0.11	0.087	0.087	NA
2-Amino-4,6-DNT	16	5	ND	0.28	0.091	0.038	NA
4-Amino-2,6-DNT	16	0	NA	NA	NA	NA	NA
1,3,5-TNB	16	0	NA	NA	NA	NA	NA
RADIONUCLIDES (pCi/L)							
Uranium-233/234	26	26	0.17	22	4.38	1.415	NA
Uranium-235	26	19	ND	0.98	0.25	0.13	NA
Uranium-238	26	25	ND	42	4.77	1.1	NA
Thorium-228	10	6	ND	4.81	1.61	1.46	NA
Thorium-230	26	25	ND	27	5.04	1.2	NA
Thorium-232	26	18	ND	24	5.73	2.6	NA
Strontium-90	23	23	0.26	19	3.12	1.7	NA

Sources: SNL 1995c, SNL/NM 1996g
µg/L: micrograms per liter
DNB: Dinitrobenzene
DNT: Dinitrotoluene
HMX: High Melt Explosive
mg/L: milligrams per liter
NA: not applicable
ND: not detected
pCi/L: picocuries per liter
RDX: Research Development Explosive
TNB: Trinitrobenzene
TNT: Trinitrotoluene
[a] Most stringent standard for designated use from 20 NMAC 6.1 (NMWQCC 1994)

4.7 BIOLOGICAL AND ECOLOGICAL RESOURCES

4.7.1 Definition of Resource

Biological resources are the plants and animals that live on or otherwise rely on lands at KAFB and contiguous lands for their continued existence. Biological resources include the habitats where plant and animal species live, as well as the plants, animals, and ecosystems that the Federal and state governments and agencies specifically address as protected or deserving of special consideration in planning and management activities.

4.7.2 Region of Influence

The ROI consists of KAFB, the Withdrawn Area, and the DOE buffer zones adjacent to the southwest corner of KAFB. In addition, it includes the adjacent lands to which animals regularly travel.

4.7.3 Affected Environment

4.7.3.1 Overview

KAFB is located at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert (Brown 1982). Each province influences the existing biological communities. KAFB contains a diversity of biological resources due, in part, to these influences and an elevation change from a low point of approximately 5,200 ft in Tijeras Arroyo to a high point of 7,715 ft at Mt. Washington in the Manzanita Mountains.

Early biological data at KAFB have been collected primarily for specific projects (Biggs 1991; IT Corp. 1995; SNL 1994a). Broad-scale studies include sensitive species surveys on KAFB (New Mexico Natural Heritage Program [USAF 1995d]), and wetland surveys (USACE 1995). More recently, plant and vertebrate animal inventories have been completed for portions of KAFB (SNL/NM 1997a, USAF 1997b, and SNL/NM 1997u).

4.7.3.2 Biodiversity

At least 267 plant species and 195 animal species occur on KAFB (SNL/NM 1997a). This diversity is due, in part, to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, as well as the four major vegetation associations, which are grassland, woodland, riparian, and altered. Restricted access and limited planned development have benefited biological resources at KAFB.

The exclusion of livestock for the past 50 years on KAFB appears to have had a beneficial effect on the vegetation in that the USAF policy of grazing curtailment has allowed the grassland sites to recover somewhat from the heavy grazing pressures of the previous three centuries (Parmenter & Chavez 1995). The presence of grama grass cactus may be due to this lack of grazing. The state of New Mexico delisted grama grass cactus as endangered in 1995, partially as a result of the populations found during surveys on KAFB (SNL/NM 1997a).

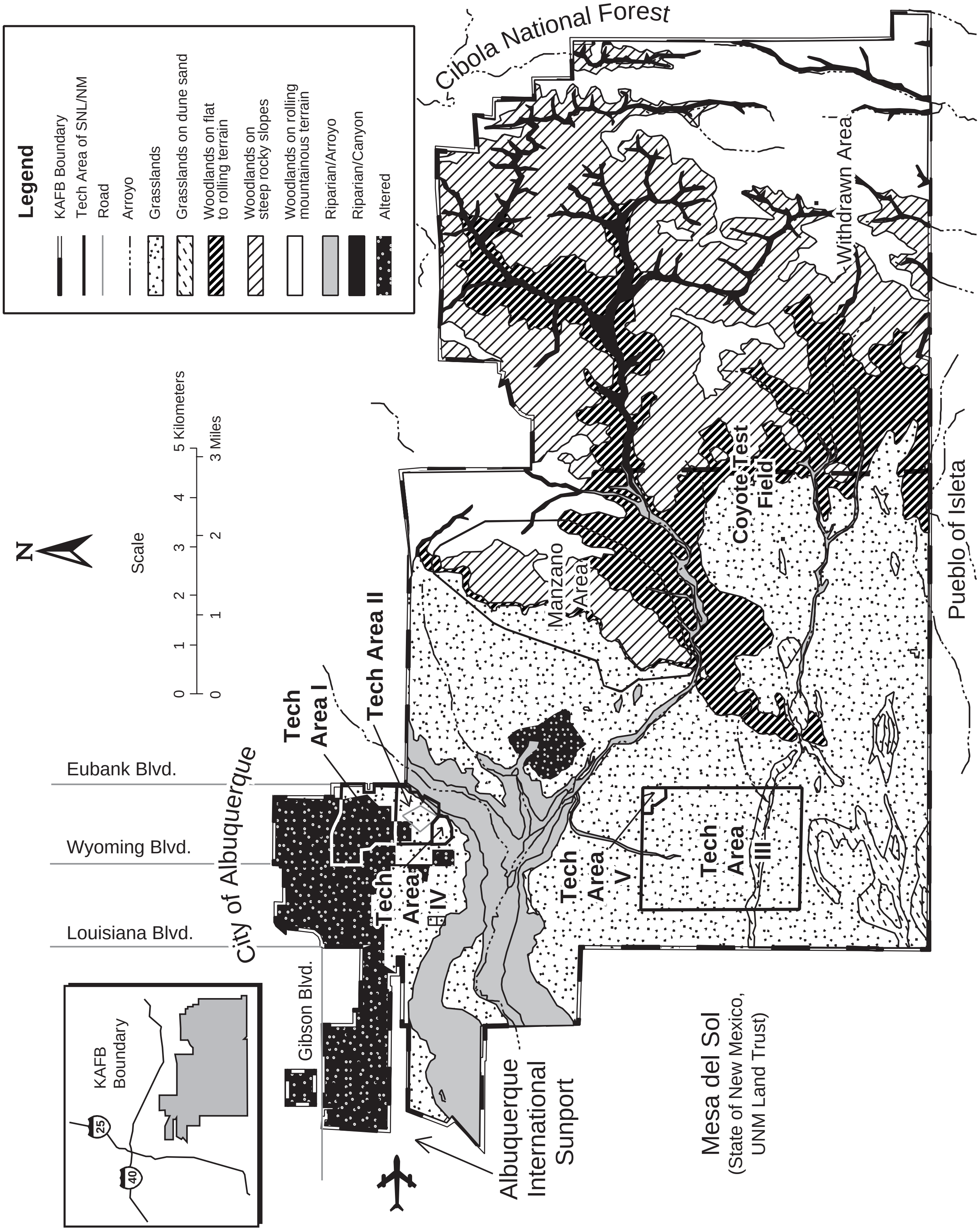
Plants

The four major vegetation associations at KAFB, grassland, woodland, riparian, and altered, are distinct in the form and composition of their vegetation (USAF 1996). Figure 4.7–1 shows the areal extent and location of the major natural vegetation associations on KAFB.

The grassland association occupies the lower alluvial slopes and terrace surfaces of the Rio Grande valley near the city of Albuquerque. It is the dominant vegetation association on KAFB, west of the Withdrawn Area. Coyote Test Field and TAs-I, -II, -III, -IV, and -V are on grasslands. Selected plant species common in the grasslands are listed in Table 4.7–1.

Woodland vegetation occurs primarily on the upper alluvial slopes and mountainous areas of the Withdrawn Area. Species generally found in the 6,000- to 6,200-ft elevation range include one-seed juniper with a groundcover that includes blue grama. Pinyon pine-juniper woodland, at an elevation of 6,200 to 6,500 ft, is characterized by an even mix of pinyon pine and one-seed juniper. The numbers of ponderosa pine have declined since 1850 due to fire suppression practices and climate change (Baisan & Swetnam 1994). Many areas of the woodlands are becoming progressively choked with deadwood and dense thickets of young trees (Baisan & Swetnam 1994).

Isolated, narrow bands of riparian vegetation occur along the surface drainages of KAFB. These drainages are predominantly ephemeral and contain flow only after large rainfall events. Riparian vegetation constitutes less than 5 percent of the area of KAFB. The riparian woodland vegetation is limited primarily to the upper reaches of Arroyo del Coyote and associated drainages. Common riparian plant species are listed in Table 4.7–1. The sites contain dense stands of trees where the water table is close to land surface, such as at G Spring and Coyote Springs. The riparian woodland vegetation is dominated by exotic species, principally salt cedar, which



Source: SNL/NM 1997j

Figure 4.7–1. Major Vegetation Associations at KAFB

The diversity of plant and animal species on KAFB is due, in part, to the presence of four major vegetation associations.

Table 4.7–1. Selected Plant Species Common in the Vegetation Associations Occurring on KAFB

COMMON NAME	SCIENTIFIC NAME	VEGETATION ASSOCIATION
Black Grama	*Bouteloua eriopoda*	Grasslands
Blue Grama	*Bouteloua gracilis*	Grasslands
Fourwing Saltbush	*Atriplex canescens*	Grasslands
Galleta	*Hilaria jamesii*	Grasslands
Sand Sagebrush	*Artemisia filifolia*	Grasslands
Apache Plume	*Fallugia paradoxa*	Riparian
Fremont Cottonwood	*Populus fremontii*	Riparian
Salt-Cedar	*Tamarix pentandra*	Riparian
Siberian Elm	*Ulmus pumila*	Riparian
Tree-of-Heaven	*Ailanthus altissima*	Riparian
Gambel Oak	*Quercus gambellii*	Woodlands
Mountain Mahogany	*Cercocarpus montanus*	Woodlands
Pinyon Pine	*Pinus edulis*	Woodlands
Ponderosa Pine	*Pinus ponderosa*	Woodlands
One-Seed Juniper	*Juniperus monosperma*	Woodlands
Wavy-Leaf Oak	*Quercus undulata*	Woodlands
Cattail	*Typha latifolia*	Wetlands
Three-square	*Scirpus americanus*	Wetlands
Torrey Rush	*Juncus torreya*	Wetlands
Wire Rush	*Juncus balticus*	Wetlands
Poplar	*Populus spp.*	Altered
Russian Thistle	*Salsola kali*	Altered
Summer Cypress	*Cupressus arizonica*	Altered

Sources: Parmenter & Chavez 1995; SNL 1997a, 1994a; SNL/NM 1974; USACE 1995

is widespread in the arroyos on KAFB (SNL/NM 1997a). They form dense stands on Arroyo del Coyote at G Spring and near Coyote Springs. Large, mature native Fremont cottonwood trees occur where there is a sufficient subsurface water supply.

Human development and activities have created altered vegetation associations at KAFB. This vegetation ranges from no vegetative cover to manicured landscapes, such as the golf course. Most of this vegetation consists of nonnative species. Common plant species in altered vegetation are listed in Table 4.7–1.

Aquatic Habitat

Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 1 acre in size. KAFB has six wetlands, all associated with springs (USACE 1995) (Figure 4.6–6). These wetlands are designated as jurisdictional wetlands under Section 404 of the CWA, because they have the soils, hydrology, and vegetation that meet standard criteria (USACE 1995). The largest wetland is Coyote Springs in Arroyo del Coyote. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail (USACE 1995). Only the Burn Site Spring is on land used by SNL/NM. The USFS manages a tank that collects water for wildlife at this spring and Sol se Mete Spring. The USAF administers constructed ponds on KAFB Tijeras Arroyo Golf Course and a constructed lake, Christian Lake, in the southern part of KAFB.

Animals

Each of KAFB's vegetation associations support a distinct assemblage of animal species, which include amphibians, reptiles, birds, and mammals. Each species exhibits specific habitat requirements for food, water, and cover, as well as behaviorally controlled requirements, such as travel corridors (areas through which animals habitually move), breeding site preferences, and sensitivity to human activity. Because of their mobility, bird communities are particularly dynamic. Although some bird species at KAFB are resident throughout the year, many are migratory. They are only present seasonally, breeding, wintering, or traveling between their breeding and wintering grounds.

The most important ecological factor that controls wildlife communities on KAFB is the limited availability of surface water (USAF 1996). Selected common animal species and habitats on KAFB are listed in Table 4.7–2.

Large predators in the woodlands include the mountain lion and the black bear. The mule deer is the only large herbivore known to use KAFB and is also the principal game animal. Grassland-juniper vegetation in the foothills surrounding Lurance Canyon and Sol se Mete Canyon is an important winter range for mule deer (Biggs 1991).

Table 4.7–2. Selected Common Animal Species and Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	HABITAT TYPE
American Kestrel	*Falco sparvertius*	Grasslands
Coyote	*Canis latrans*	Grasslands
Deer Mouse	*Peromyscus maniculatus*	Grasslands
Desert Cottontail	*Sylvilagus auduboni*	Grasslands
Red-Tailed Hawk	*Buteo jamaicensis*	Grasslands
Whiptail Lizard	*Cnemidophorus spp.*	Grasslands
Ash-Throated Flycatcher	*Myiarchus cinerascens*	Woodlands
Cooper's Hawk	*Accipiter cooperii*	Woodlands
Mule Deer	*Odocoileus hemionus*	Woodlands
Northern Flicker	*Colaptes auratus*	Woodlands
Rock Squirrel	*Spermophilus variegatus*	Woodlands
Scrub Jay	*Aphelocoma coerulescens*	Woodlands
Lark Sparrow	*Chondestes grammacus*	Riparian
Gray Fox	*Urocyon cinereoargenteus*	Riparian
Red-Spotted Toad	*Bufo puntatus*	Riparian
Violet-Green Swallow	*Tachycineta thalassina*	Riparian
Barn Swallow	*Hirundo rustica*	Altered
European Starling	*Sturnus vulgaris*	Altered
House Sparrow	*Passer domesticus*	Altered

Sources: Parmenter & Chavez 1995, SNL 1994a, SNL/NM 1997u, USAF 1995d

Drainages provide a focal point for animals due to greater availability of food, water, and cover generally found along their courses. Diversity is, therefore, generally higher in the riparian habitat, especially where surface water is available. Most large mammal species of the area inhabit the canyons and arroyos. Coyote Springs, for example, attracts mule deer and a large number of bird species.

Drainages and their associated riparian vegetation serve as important wildlife corridors. In the Withdrawn Area, the Madera and Bonita Canyons and ridgelines contain travel corridors. On a regional scale, the Manzanita Mountains are an important migratory bird corridor for neotropical migrants, including several raptor species (SNL/NM 1997a).

Many species favor habitats that are disturbed, altered, or close to human activities. Colonies of Gunnison's prairie dogs (a state sensitive species) occur in the margins of developed areas including roads, housing, runways, and the golf course. On DOE lands, the colonies are limited to TA-I. The burrows in these colonies provide nesting sites for the burrowing owl, a species protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703). The grass, ponds, and variety of trees at KAFB golf course provide a particularly rich haven for animals, including waterfowl and shorebirds.

Exposed cliffs on the west side of the Manzano Mountains provide potential nesting or roosting sites for a wide variety of birds, including raptors such as the golden eagle and peregrine falcon. Both species have been observed in that area; however, no nesting activity for either of these species has been documented. Several abandoned mines in the Manzanita Mountains provide habitat for bats.

4.7.3.3 Threatened, Endangered, and Sensitive Species

There are four agencies that have the authority to designate threatened, endangered, and sensitive species occurring in New Mexico. The agencies are the U.S. Fish and Wildlife Service (USFWS), the New Mexico Game and Fish Department (NMGFD), the New Mexico Forestry and Resource Conservation Division (NMFRCD), and the USFS. The state of New Mexico separates the regulatory authority for plants and animals between the NMFRCD and the NMGFD, respectively. The USFS lists species for special management consideration on USFS lands. The USFWS protects species under the authority of the *Endangered Species Act of 1973* and the *Migratory Bird Treaty Act*, which contains a list of migratory nongame birds for which information exists indicating declining populations. The levels of protection afforded threatened, endangered, and sensitive species on KAFB are defined in Table 4.7–3.

The Pueblo of Isleta recognizes and applies all state and Federal designations of endangered, threatened, and sensitive species to populations that occur on pueblo lands (SNL/NM 1997a). In addition, the Pueblo of Isleta considers all species occurring on pueblo lands to be of cultural importance and, therefore, protected (SNL/NM 1997a).

Plants

Table 4.7–3 lists the threatened, endangered, and sensitive species and habitats on KAFB. One state-listed sensitive plant species, the Santa Fe milkvetch, occurs on the low hills in the southwestern part of KAFB (SNL 1994a). The Strong prickly pear, found near the northern boundary of KAFB, is on the state of New Mexico Rare Plant Review List (Ferguson 1998). One USFS-listed species, the grama grass cactus, is found in areas of the grasslands.

Animals

The peregrine falcon was the only Federally listed threatened or endangered species that may frequent KAFB. A probable sighting near Mt. Washington was likely a migrant (USAF 1995d). No nesting activity of this species has been observed and KAFB contains only marginal nesting habitat (USAF 1995d). In 1997, the USAF conducted a raptor survey of KAFB and did not observe any listed raptor species (USAF 1997b).

On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (such as, dichloro-diphenyl-trichloroethane [DDT]) in the U.S. and Canada, following the implementation of successful management activities (64 FR 46541).

On February 16, 1999, the USFWS designated the mountain plover as a proposed threatened species (64 FR 7587). Although KAFB could contain potential habitat for the mountain plover, numerous avian surveys of the Withdrawn Area and KAFB in general have not documented its presence (SNL, 1997u; USAF, 1997b).

No Federally proposed or candidate species occur on KAFB. In 1993, a colony of state-listed threatened gray vireos was discovered in the western foothills of the Withdrawn Area on land controlled by the USAF. This is

Table 4.7–3. Threatened, Endangered, and Sensitive Species and their Habitats on KAFB

COMMON NAME	SCIENTIFIC NAME	STATUS	HABITAT
ANIMALS			
Baird's Sparrow	*Ammodramus bairdii*	SC, ST, FSS	Grasslands and moist meadows
Bell's Vireo	*Vireo bellii arizonae*	ST, FSS	Canyons
Black Swift	*Cyseloides niger borealis*	SS	Higher elevations
Desert Massasauga	*Sistrurus catenatus edwardsii*	FSS	Grasslands and arroyos
Ferruginous Hawk	*Buteo regalis*	SC, FSS	Grasslands and open shrublands
Gunnison's Prairie Dog	*Cynomys gunnisoni*	SS	Grasslands
Gray Vireo	*Vireo vicinior*	ST, FSS	Juniper woodlands & shrublands
Loggerhead Shrike	*Lanius ludovicianus*	SC	Shrublands & shrubby grasslands
Mountain Plover	*Charadrius montanos*	FE	Dry short-grass prairie
Pale Townsend's Big-Eared Bat	*Plecotus townsendii pallescens*	SC, SS, FSS	Caves, mines, and rock shelters
American Peregrine Falcon	*Falco peregrinus aratum*	FE, ST, FSS	Cliffs, woodlands, and streams
Small-Footed Myotis	*Myotis ciliolabrum*	SC, SS	Caves, rock crevices, and grasslands
Swainson's Hawk	*Buteo swainsonii*	FSS	Grasslands and lower slopes
Texas Horned Lizard	*Phrynosoma cornutum*	SC, FSS	Grasslands and open deserts
Texas Longnose Snake	*Rhinocheilus lecontei*	FSS	Grasslands and arroyos
Western Spotted Skunk	*Spilogale gracilis*	SS	Arroyos, canyons, and rocky slopes
Western Burrowing Owl	*Athene cunicularia hypugea*	SC	Grasslands and open shrublands
White-Faced Ibis	*Plegadis chihi*	SC, FSS	Marshes, ponds, & riparian areas
PLANTS			
Grama Grass Cactus	*Pediocactus papyracanthus*	FSS	Grasslands
Santa Fe Milkvetch	*Astragalus feenis*	NML2 FSS	Limestone hills in grasslands
Strong Prickly Pear	*Opuntia valida*	NML3	Lower elevation hills

Sources: NMDGF 1997; SNL 1994a, b; SNL/NM 1997a; USAF 1995d; USFS 1994; USFWS 1998

FE: Federal Endangered: "... Any species that is in danger of extinction throughout all or a significant portion of its range" (16 U.S.C. § 35).

SC: Federal species of concern: Species for which further biological research and field study are needed to resolve their conservation status (USFS-listed species).

FSS: USFS Sensitive Species: Species for which population viability is a concern based on current or predicted numbers, density, distribution, or habitat capability.

NML2: New Mexico List 2: Official listing of plant species that are vulnerable to extinction or extirpation within the state due to rarity or restricted distribution, but are not protected under the *New Mexico Endangered Plant Species Act*.

NML3: New Mexico List 3: Official Listing of plant species that are on the New Mexico Rare Plant Review List as species for which more information is needed, but are not protected under the *New Mexico Endangered Plant Species Act*.

ST: State Threatened: New Mexico-listed species protected as threatened under the *Wildlife Conservation Act*.

SS: State Sensitive: New Mexico-listed species: Taxa that, in the opinion of a qualified New Mexico Game and Fish Department biologist, deserve special consideration in management and planning, and are not listed threatened or endangered by the state of New Mexico. These can include taxa that are listed as threatened, endangered, or sensitive by other agencies; taxa with limited protection; and taxa without legal protection. The intent of this category is to alert land managers of the need for management where these taxa could be affected.

USFS: U.S. Forest Service

the largest known concentration of gray vireos in the state of New Mexico (USAF 1995d).

Eight species of concern have been observed on KAFB, in addition to thirteen migratory nongame birds of management concern for the USFWS, Region 2 (Table 4.7–3). These species are protected under the *Migratory Bird Treaty Act* (16 U.S.C. §703).

Four state-listed threatened animal species occur on KAFB (Table 4.7–3). Eleven USFS-listed sensitive animal species have also been observed on KAFB (Table 4.7–3). One of the state-listed sensitive species, Pale Towsend's big-eared bat, has been observed hibernating in two caves (Altenbach 1997).

4.7.3.4 Biomonitoring

Ecological monitoring of selected biota, including small mammals, birds, reptiles, amphibians, and vegetation, is conducted annually by SNL/NM. Baseline measurements are collected on potential contaminant loads in species as well species density and composition. In 1997, data were collected at two sites: TA-II and a site at the southeastern end of the perimeter fence separating the Pueblo of Isleta and KAFB. Analysis of samples of seven small mammals from these sites did not show any significant radionuclide or metal contamination (SNL/NM 1997u).

SNL/NM recently completed an ecological risk assessment validation study (SNL/NM 1999d). This study was conducted for the SNL/NM ER project to provide site-specific data in support of the ecological risk assessment currently being used to evaluate potential risks to natural populations at contaminated sites. The field work for this study included both biomonitoring and quantitative surveys of key populations at potential ecological risk. Biomonitoring consisted of the collection of soil, plant, invertebrate, and small mammal samples from four ER Project sites and the analysis of these samples to determine the concentrations of 18 selected inorganic analytes. No significant effects to small mammal communities were found at any of the sites. A report presenting the results of these studies is currently in preparation. The study objectives recommended by the U.S. Department of Interior will be considered in ongoing study objectives.

4.7.3.5 Ecosystems Management

KAFB is bordered by Cibola National Forest and the Pueblo of Isleta. Sensitive species and other wildlife travel across the management boundaries of the Pueblo of Isleta and the national forest, where biological resources are valued and actively used for recreational, cultural, and aesthetic purposes. Many of the sensitive biological resources on KAFB are on the lands the DOE and the USAF have withdrawn from the USFS (Cibola National Forest). SNL/NM conducts activities on these DOE and USAF lands, but the USFS retains management responsibilities for their natural resources. Management measures are delineated in the *Ecosystem Management Plan for National Forest Lands in and Adjacent to the Military Withdrawal, Sandia Ranger District, Cibola National Forest, Bernalillo County, New Mexico* (USFS 1996) and the 1985 *Cibola National Forest Land and Resource Management Plan,* as amended (USFS 1985). The USFS's emphasis in the Withdrawn Area is to improve wildlife diversity and decrease the threat of an escaped wildfire. USFS fire management practices include thinning vegetation, constructing fuel breaks, and prescribed burning. The USFS has stated that the desired condition for the Withdrawn Area is one in which the public feels that the area is a "special wildlife haven" over which it has stewardship (USFS 1995).

On KAFB, the USAF manages wildlife resources, wetlands, land resources, and outdoor recreation through guidance outlined in several documents. The *Integrated Natural Resources Management Plan* (INRMP), *Kirtland Air Force Base, New Mexico* was developed to provide interdisciplinary strategic guidance for natural resource management (USAF 1995a). As a result of the INRMP, two additional plans were developed to aid in natural resources management. The *Kirtland Air Force Base Fish and Wildlife Plan* (FWP) addressed the protection and management of the naturally occurring populations of vertebrate wildlife species on KAFB (USAF 1996). The *Kirtland Air Force Base 1997 Raptor Survey and Management Strategies*, following the suggested guidance of the INRMP and the FWP, identified existing species and numbers of raptors, presented suggestions on habitat improvement, and gathered information on raptor preservation (USAF 1997b).

4.8 CULTURAL RESOURCES

4.8.1 Definition of Resource

Cultural resources are prehistoric or historic sites, buildings, structures, districts, or other places or objects considered to be important to a culture, subculture, or community for scientific, traditional, or religious purposes, or for any other reason. Cultural resources primarily addressed in the SWEIS are those that have been recommended as or determined to be eligible or potentially eligible for inclusion in the National Register of Historic Places (NRHP) and those that are Traditional Cultural Properties (TCPs). TCPs are places or objects that have religious, sacred, or cultural value for a particular cultural group. In order to be included in the NRHP, a resource must meet one or more of the following criteria (36 CFR Part 60):

- Criterion A—Associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B—Associated with the lives of persons significant in our past.
- Criterion C—Embodies the distinctive characteristics of a type, period, or method of construction.
- Criterion D—Yielded or may be likely to yield information important in prehistory or history.

The resource must also retain most, if not all, of seven aspects of integrity: location, design, setting, workmanship, material, feeling, and association.

Cultural resources considered in the SWEIS are divided into three categories. The first is prehistoric archaeological sites, which in the Albuquerque area date to before A.D. 1540, when Francisco Vasquez de Coronado and his expedition arrived in the middle Rio Grande valley and initiated Spanish exploration of the area. The second category, historic sites, includes archaeological sites as well as buildings and structures dating from A.D. 1540 to 1948. Based on the standards of the National Park Service (NPS), the cutoff date for being categorized as a historic resource is 50 years in age, which provides the historical perspective necessary to evaluate significance. However, this category also includes younger resources (post-1948) that have been recommended as *exceptionally significant* within one of the criteria. The third category consists of TCPs. TCPs can include resources that fall within the previous two categories.

4.8.2 Region of Influence

The ROI includes KAFB and the DOE buffer zones adjacent to the southwest corner of KAFB. The resources include those already identified, as well as those that have not yet been identified, such as buried archeological sites, TCPs, and unassessed resources. The ROI is further refined into areas of potential effect to cultural resources for the various activities performed at SNL/NM use areas.

4.8.3 Affected Environment

4.8.3.1 Overview of Cultural Resource Inventories and Sites

SNL/NM is located along the middle Rio Grande valley. The valley has been consistently inhabited for thousands of years, and contains present-day Puebloan cultural groups who have ancestral ties to the area. Archaeological resources and TCPs hold important roles within the traditional cultures of these groups and of groups that are farther away. These resources are not just contained in the groups' traditions and oral histories, but play an active part in continuing a way of life that has been in existence since the groups' origins. Cultural resources are also important to the scientific community and to the general public as a key to understanding the vast prehistory and history of this region.

Since the first documented survey in 1936, well before the establishment of KAFB, both KAFB and the DOE buffer zones have been the subject of cultural resource studies (Figure 4.8–1). Over 160 cultural resource investigations, reports, and studies have been conducted, most in the last 10 years. While many of these studies are extremely limited in scope, others are broad and apply to the entire KAFB. Approximately 75 percent of the ROI has been studied for cultural resources (Trierweiler 1998, SNL/NM 1997a).

Within the boundaries of KAFB and the DOE buffer zone, 284 prehistoric and historic archaeological sites have been recorded, of which 192 have been recommended as eligible or potentially eligible for the NRHP. The resources range from prehistoric Native American campsites to historic Euro-American placer mining pits. Of the prehistoric archaeological sites, campsites are the most common, followed by sites of limited activity (such as stone tool production), then habitations. Of the historic sites, mining sites are the most common, followed by habitations, then sites related to agriculture and ranching, then small, isolated trash scatters (Trierweiler 1998).

Five hundred seventy-nine architectural properties have been recorded and assessed for NRHP eligibility within KAFB boundaries, of which nine individual properties have been recommended as eligible or potentially eligible for the NRHP (Trierweiler 1998; USAF 1998a; Tuttle 1998). Most of them were recorded by the 377th Air Base Wing of KAFB, under the auspices of the U.S. Department of Defense (DoD) Legacy Program, and are on KAFB lands. Few of these properties predate World War II, and most were constructed during the 1940s and 1950s (Trierweiler 1998). In addition, the architectural properties in TA-II, as a group, are eligible to the NRHP as

Source: SNL/NM 1997j

Figure 4.8–1. Areas Inventoried for Cultural Resources in KAFB and the DOE Buffer Zones

Over 160 cultural resource studies have been conducted on KAFB and the DOE Buffer Zones.

a district. A more detailed discussion of the cultural resources at KAFB is provided in Appendix C.

Unidentified Sites

Despite the large number of cultural resource inventories conducted on KAFB, cultural resources probably exist that have not yet been identified or recorded. Even in areas that have been inventoried, data collected on resource locations could be incomplete due to human error or conditions such as heavy vegetation cover, which can seriously affect the ability to see sites on the ground. In addition, archaeological sites may be buried (Frederick 1992, Frederick & Williamson 1997, Larson et al. 1998, Abbott et al. 1997, Doleman 1989).

Settlement Patterns

Previous archaeological research on KAFB indicates definite patterns in the location and densities of cultural resources on KAFB (Figure 4.8–2). These patterns can be used to predict if sites are likely to exist in an area and, if so, their probable density. Known archaeological sites on KAFB are primarily concentrated in four areas. Two areas along Arroyo del Coyote contain the largest concentrations of sites: one in the area southeast of the Manzano Area and the other in the Withdrawn Area near the headwaters of Arroyo del Coyote, where tributaries from the mountains flow into Coyote Canyon. A third concentration of sites is in the southwest corner of the Withdrawn Area in the upper elevations. Finally, a smaller concentration of sites is found along Tijeras Arroyo in the northwest portion of KAFB.

4.8.3.2 Cultural Resource Protection in the ROI

Because activities within KAFB are conducted by Federal agencies, contractors to Federal agencies, and private entities under agreement with Federal agencies, there are a number of laws, regulations, and executive orders applicable to Federal agencies that protect cultural resources and access to resources that are sacred or ceremonial sites on KAFB (see Chapter 7). Each of the agencies in the ROI (DOE, USAF, and USFS) has implementing policies and procedures that follow these regulations. In addition, there are personnel assigned within each agency with responsibility for overseeing compliance with the policies and procedures implemented by their respective agencies. Proposed undertakings in the ROI undergo review by the responsible Federal agency to determine if eligible cultural resources could be effected by the undertaking. Consultations between the agencies and the New Mexico State Historic Preservation Officer (SHPO) take place as required. Agencies and the SHPO consult on measures that can be implemented to mitigate or avoid any potential adverse effects.

4.8.3.3 Cultural Resources by Land Use Type

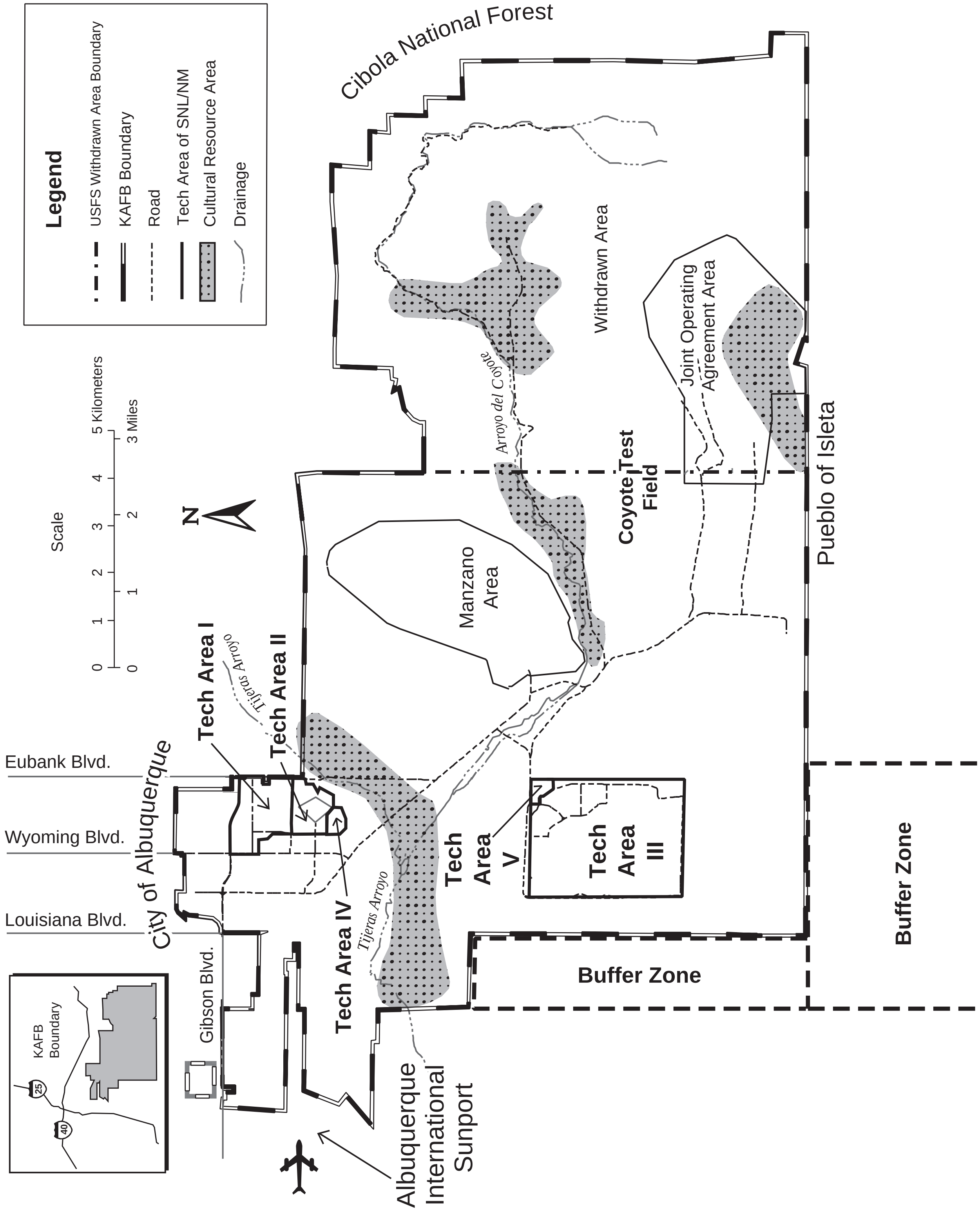
KAFB Lands Owned by the DOE and Used by SNL/NM

TAs-I through -V have been completely inventoried for archaeological sites (both prehistoric and historic) (Hoagland 1990 a,b,c,d,e; Lord 1990). Although TAs-II and -IV are in an area that likely contains sites (adjacent to Tijeras Arroyo), aside from isolated occurrences of artifacts, no prehistoric or historic archaeological sites have been identified there. The vast majority of buildings and structures used by SNL/NM are less than 50 years old, and thus have not been assessed for eligibility for inclusion in the NRHP. Assessments have not been conducted for buildings and structures in TAs-III, -IV, and -V; thus, their eligibility to the NRHP is unknown. Fifty-two buildings in TA-I were assessed and determined to be ineligible (Hoagland 1991, 1993; Sebastian 1993; Merlan 1993). The remaining buildings and structures in that area have not been assessed due to their young age. As the buildings in the four TAs attain the 50-year mark, the DOE will assess them for eligibility for inclusion in the NRHP (Merlan 1991). TA-II has been determined to be eligible to the NRHP as a district, with most of the larger buildings contributing to that status (DOE 1998o).

The DOE is responsible for the cultural resources contained in these TAs and has adopted implementing policies and guidelines that address the management of cultural resources. The DOE does not have a cultural resource management plan for the land it owns on KAFB due to the paucity of sites on these lands.

Other KAFB Lands Used by SNL/NM Through Land Use Agreements

A number of cultural resource inventories on KAFB have included areas used by SNL/NM through various land use agreements with the USAF and the USFS. These areas have been completely surveyed for cultural resources, except for the southeastern one-third of the Joint Operating Agreement Area (Starfire Optical Range) (Figure 4.8–1). In the areas that have been inventoried, archaeological sites are frequent only in the areas coinciding with the settlement patterns discussed previously, such as the Joint Use Agreement Area



Source: SNL/NM 1997j

Figure 4.8–2. Areas With a Concentration of Archaeological Sites on KAFB and the DOE Buffer Zone

Known archaeological sites on KAFB are primarily concentrated in four areas.

(uplands), the DOE Withdrawn Area used by SNL/NM as a buffer for the Lurance Canyon Burn Site (near a tributary to Arroyo del Coyote), and the DOE permit area along Arroyo del Coyote. The unsurveyed portion of the Joint Use Agreement Area is likely to contain sites based on the high density of sites located in the adjacent inventoried areas. No building or structure assessments have been conducted in these areas.

Responsibility for managing the cultural resources contained in these areas falls to the agency that owns the specific parcel of land, though the land use agreements usually stipulate that the DOE must conduct the necessary studies to determine if an area scheduled for DOE activities contains cultural resources. For KAFB areas permitted to the DOE, the guidelines and policies of the USAF direct managing cultural resources in concert with the KAFB cultural resource management plan (Trierweiler 1998). For the entire Withdrawn Area, the management of cultural resources follows the policies and procedures of the USFS, along with the guidelines presented in the *Cibola National Forest Land and Resource Management Plan* (USFS 1985). The DOE and the USFS have two separate memorandums of agreement (dated May 15, 1989, and January 22, 1987) that address agency responsibilities on portions of the Withdrawn Area.

The DOE Buffer Zones Used by SNL/NM

SNL/NM uses two areas outside and adjacent to the KAFB boundary. These areas, leased from the state of New Mexico and the Pueblo of Isleta, comprise the DOE buffer zones. The land leased from the state of New Mexico has undergone a 20-percent cultural resource sample inventory (Doleman 1989). This inventory identified three archaeological sites within the leased area, one of which is eligible to the NRHP and the other two are potentially eligible. The land leased from the Pueblo of Isleta has not undergone a cultural resource inventory and no cultural resources are currently known in this area (Geister 1998). Based on the settlement patterns evident on adjacent KAFB areas, a low density of archaeological sites in both these areas is expected. No building or structure assessments have been conducted on either leased area. Responsibility for the cultural resources in these areas is retained by the land-owning agencies (state of New Mexico or Pueblo of Isleta/BIA).

KAFB Lands Not Used by SNL/NM

Cultural resource inventories conducted on KAFB have also included areas not used by SNL/NM. Locations of archaeological sites in these areas follow the settlement patterns discussed previously, such as along Tijeras Arroyo, Arroyo del Coyote, and in the uplands near the Joint Use Agreement Area. Some inventories assessed the eligibility of certain buildings and structures. Of these areas, the DOE is responsible only for those areas owned by the DOE (Table 4.3–1), which may be used by, permitted to, or out-granted to other agencies.

4.8.3.4 Traditional Cultural Properties

A TCP is a place or object that is significant to a particular living community. This significance is “derived from the role the TCP plays in the community’s historically rooted beliefs, customs, and practices” (NPS 1990). TCPs are associated with the cultural practices and beliefs that are rooted in a community’s history and important in maintaining the cultural identity of the community.

Consultations to identify TCPs were conducted for the purposes of the SWEIS. Consultations were held with 15 Native American tribes with a cultural interest in the area to determine the presence of cultural properties significant to them within the ROI (Appendix C). No specific TCPs have yet been identified through these consultations. Although no specific locations have been identified during these consultations, some tribes have stated that they have concerns for cultural sites in the ROI that are important to them. Consultations will continue with some tribes, which could lead to the identification of TCPs in the future. A more detailed discussion of the TCP study methods and results can be found in Appendix C.

4.9 AIR QUALITY

4.9.1 Nonradiological Air Quality

4.9.1.1 Definition of Resource

Ambient air quality is determined by measuring or modeling ambient pollutant concentrations and comparing the concentrations to the corresponding standards. As directed by the *Clean Air Act* (CAA) of 1970 (42 U.S.C.§7401), the EPA has set the National Ambient Air Quality Standards (NAAQS) for several criteria pollutants to protect human health and welfare (40 CFR Part 50). These pollutants include particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, and ozone. The Draft SNL/NM SWEIS indicated that on September 16, 1997, a new NAAQS became effective for particulate matter with a size classification defined as less than or equal to 2.5 microns in diameter ($PM_{2.5}$). This new standard would have been in addition to the PM_{10} NAAQS. It is estimated that the new $PM_{2.5}$ standard, if it had gone into effect, would not have required local area controls until about 2005 and that compliance determinations would not have been required until around 2008. However, on May 14th, 1999, the U.S. Court of Appeals for the District of Columbia overturned the new air quality standards.

On June 5, 1998, ambient air quality became subject to a new 8-hour, 0.08-ppm ozone standard, replacing the previous 1-hour, 0.12-ppm ozone standard (63 FR 31034). This new ozone standard was also overturned on May 14, 1999. Under the new standard, in the year 2000, the EPA would have designated areas that did not meet the 8-hour standard based on the most recently available 3 years of ozone data available at that time (that is, 1997 through 1999).

A primary NAAQS has been established for carbon monoxide, and both primary and secondary standards have been established for the remaining criteria pollutants. Primary NAAQS define levels of air quality judged necessary, with an adequate margin of safety, to protect public health. Secondary NAAQS define levels of air quality judged necessary to protect public welfare from any known or anticipated adverse effects of a pollutant.

Air quality for SNL/NM is governed by regulations promulgated locally by the Albuquerque/Bernalillo County Air Quality Control Board (A/BC AQCB) and Federally by the EPA. The EPA has delegated authority for regulating sources under the CAA to the state of New Mexico. In turn, the state of New Mexico has delegated authority for regulating sources to the A/BC AQCB, located in Bernalillo county.

The A/BC AQCB promulgates regulations in 20 NMAC 11 for compliance with the CAA, as well as applicable state and local air quality requirements. The Albuquerque Environmental Health Department (AEHD) Air Quality Division (AQD) administers the regulations promulgated by the A/BC AQCB (SNL/NM 1997a). The New Mexico Environmental Improvement Board (NMEIB) has established ambient air quality standards (20 NMAC 2.3) that are generally more stringent than the Federal standards and that incorporate additional standards for hydrogen sulfide and total reduced sulfur. In addition to the criteria pollutants provisions, the EPA established in 40 CFR Part 62 the National Emission Standards for Hazardous Air Pollutants (NESHAP) and Title III of the 1990 CAA Amendments, which define hazardous air pollutants (HAPs). The primary nonradiological pollutants considered in the SWEIS are criteria pollutants and chemical pollutants.

Chemical pollutants include the 188 HAPs defined by the EPA in Title III of the CAA. Also included are other potentially toxic chemical air pollutants for which occupational exposure limits (OELs) have been defined by various organizations, including those chemicals categorized as volatile organic compounds (VOCs) (any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA administrator as having negligible photochemical reactivity). The OEL used for this analysis is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.

4.9.1.2 Region of Influence

The ROI is defined in the *New Mexico Air Pollution Control Bureau Dispersion Modeling Guidelines* (NMAPCB 1996) as the maximum extent of a source's significant impact. Significant impact is provided for each of the criteria pollutants as a specific concentration for a given averaging period (for example, 5.0 $\mu g/m^3$ for nitrogen oxide for a 24-hour averaging period). The maximum extent of significant ambient concentrations for the primary stationary source at SNL/NM (the steam plant) is approximately 15 mi for nitrogen oxide. The ROI for nonradiological air quality is, therefore, an area approximately 15 mi in radius about the SNL/NM steam plant. The steam plant is the primary stationary source at SNL/NM and determines the maximum extent of significant ambient concentrations (Figure 4.9–1).

The area contained within a 15-mi radius around the steam plant falls largely within the Albuquerque air basin and within Bernalillo county, with a small portion extending into northern Valencia county.

4.9.1.3 Affected Environment

The 1996 baseline air quality at SNL/NM and the ambient air quality within the ROI represent the affected environment. SNL/NM's contribution to the ambient air quality of the affected environment is based on its sources of emissions. The primary stationary sources of criteria pollutants are the steam plant boilers (which represent more than 90 percent of the total emissions of criteria pollutants), Building 862 generators, and the fire testing facilities located at the Lurance Canyon Burn Site (SNL/NM 1997a). Other sources are spatially separated, thereby contributing minimal impacts. Emissions of chemical air pollutants include those from facilities that release chemicals to the atmosphere and from operations at the burn site.

Meteorology and Climatology

The climate at SNL/NM and in the surrounding region is semiarid. The ambient temperatures in the region are characteristic of high-altitude, dry continental climates. Winter daytime temperatures average approximately 50°F, with nighttime temperatures often dropping into the low teens. Summer daytime temperatures generally do not exceed 90°F, except in July, when average maximum temperatures reach 93°F. The Albuquerque basin is characterized by low precipitation, averaging between 7.5 and 10 inches a year. Most of this precipitation falls from July through September and usually occurs from thunderstorm activities and the intrusion of warm, moist tropical air from the Pacific Ocean. The storms are accompanied by localized heavy wind gusts. Winter months are typically dry, with less than 2 inches of precipitation and limited snowfall. The average annual relative humidity is about 43 percent. New Mexico has one of the greatest frequencies of lightning in the U.S. Tornadoes are uncommon in the Albuquerque basin (SNL/NM 1997a).

Temperature, relative humidity, and precipitation do not vary dramatically across the region. Daily and seasonal wind patterns occur near the mountains and plateau. Daytime upslope flows are usually coupled with downslope flows during the night. Strong springtime, easterly winds occur near canyons, and light north-south flows occur in the Rio Grande valley.

In general, areas closer to the mountains or canyons experience more frequent winds from an easterly direction at night. Daytime wind patterns are not as pronounced, but generally flow toward the mountains or along the Rio Grande valley. The Rio Grande valley experiences the most frequent calm conditions and the lowest average wind speed. In most areas, the nighttime wind direction frequency produces the most dominant average annual direction.

Ambient Air Quality

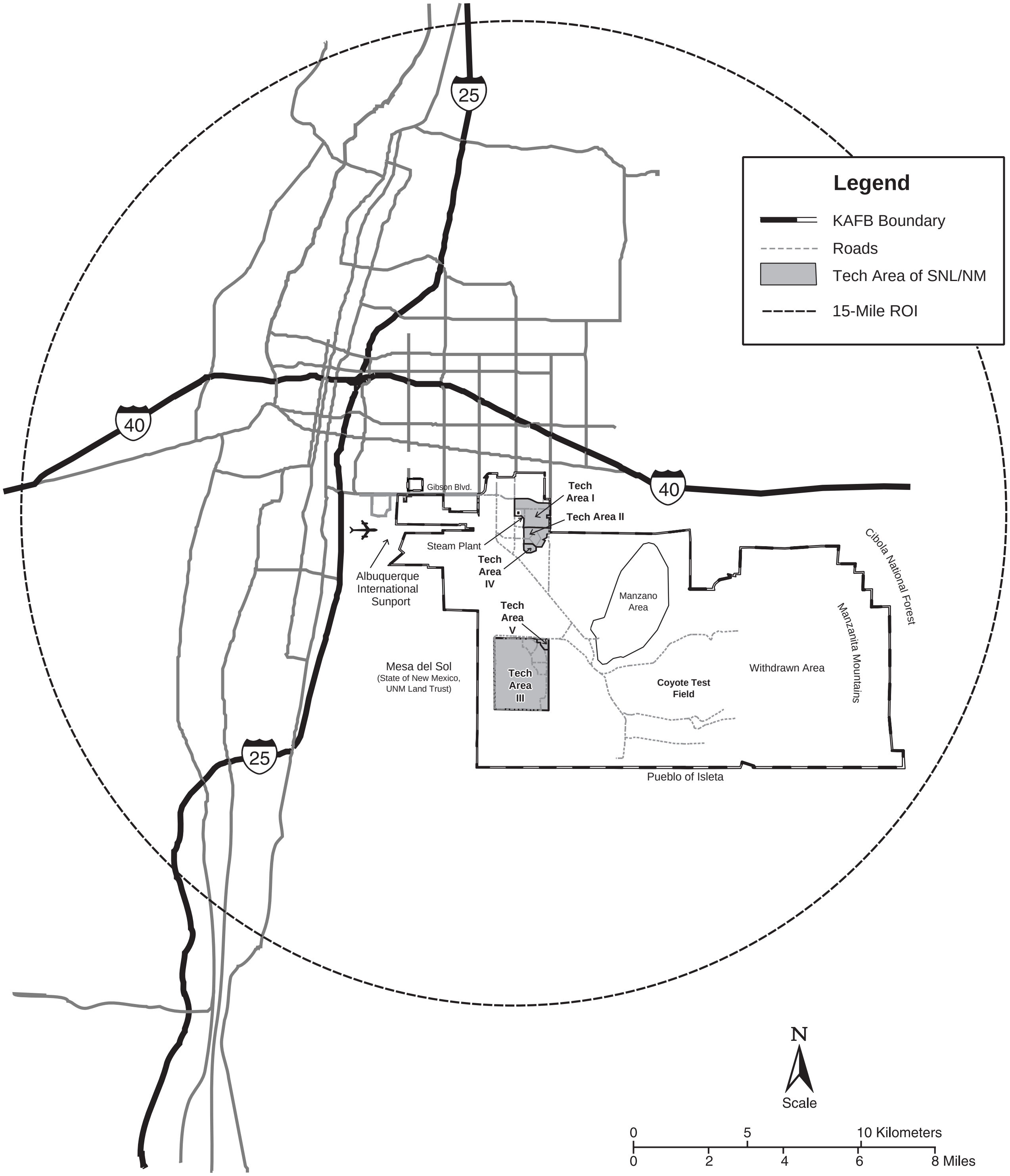
This section describes the existing ambient air quality, which includes regional and SNL/NM air quality. Existing air quality in the region and for SNL/NM is defined by air emissions and air quality monitoring data.

Regional Air Quality

From 1978 through 1996, the EPA classified the Albuquerque/Bernalillo county region as a nonattainment area for carbon monoxide. In 1983, the area experienced 74 violations of the NAAQS for carbon monoxide. Control measures, such as the vehicle emissions testing, oxygenated fuels programs, and the winter "No Burn" program, have helped decrease the amount of carbon monoxide pollution and reduce the number of NAAQS violations. The Federal Motor Vehicle Control Program, which requires improved emissions standards for new cars, has also been a major factor in reduced vehicle emissions. Since 1992, the region has not violated NAAQS standards (COA n.d. [no date] [d]). On July 15, 1996, the EPA redesignated the region from nonattainment to a maintenance level for carbon monoxide.

Few industrial emission sources exist in the region. However, more than one-third of New Mexico's population lives in the Albuquerque metropolitan area and the population is projected to increase an average of 10,000 to 15,000 per year. With increased population comes more motor vehicles, new development and housing, new employment, and more (often longer) commutes to work. Major sources of air emissions result from using motor vehicles, the seasonal use of wood-burning stoves and fireplaces, and open burning activities (COA n.d.[d]).

The dry climate, unpaved roads and parking lots, and wood-burning activities are primary sources of dust particles (PM_{10}) that cause poor visibility. The dry



Source: SNL/NM 1997a

Figure 4.9–1. Air Quality Region of Influence

The region of influence for nonradiological air quality extends 15 mi around the SNL/NM steam plant.

conditions result in poor soil stabilization, thereby increasing dust from agriculture, construction activities, and roads. These all contribute to high levels of particulate matter in the air. These conditions can also clog air filters in vehicles, reducing air flow to carburetors. The high elevation of this region results in incomplete and less efficient fuel burning and increased carbon monoxide emission. Wood and open burning activities also contribute to carbon monoxide pollution. However, motor vehicles have been, and continue to be, the major source of carbon monoxide (COA n.d.[d]).

SNL/NM is in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region (AQCR) 152 (40 CFR §81.83). The EPA has classified this AQCR as follows:

- Better than national standards – sulfur dioxides
- Unclassifiable/attainment – ozone
- Unclassifiable – PM_{10}
- Cannot be classified or better than national standards – nitrogen dioxide
- Maintenance – carbon monoxide
- Not designated – lead (40 CFR §81.332)

Wood burning has been an important contributor to the visible winter brown cloud. In 1985, a "No Burn" program, from October through February, began on a voluntary basis. This program, now mandatory, has become an important element of the A/BC AQCB's program for carbon monoxide abatement. The program prohibits operating a solid fuel heating device within the woodsmoke-impacted area during a declared no-burn period unless the device is a wood heater that has been emission-certified by the EPA. In recent years, the "No Burn" program has resulted in improved visibility on calm winter nights and mornings, as well as reductions in monitored carbon monoxide levels.

The AEHD and the NMED monitor the ambient air in the Albuquerque basin to determine the air quality in neighborhoods, background locations, and expected maximum impact locations and to estimate impacts from mobile vehicles. Fourteen monitoring stations throughout the Albuquerque basin measure criteria pollutants, including carbon monoxide, nitrogen dioxide, PM_{10}, and ozone. These monitoring stations do not measure lead or sulfur dioxide. An additional station, the Criteria Pollutant Monitoring Station (CPMS) located in TA-I, measures lead and sulfur dioxide. Figure 4.9–2 presents the locations of ambient air monitoring stations within the Albuquerque basin (except for station 3ZC, located at Bandelier National Monument, approximately 50 mi north-northeast of SNL/NM). Figure 4.9–3 presents the monitoring stations located within KAFB.

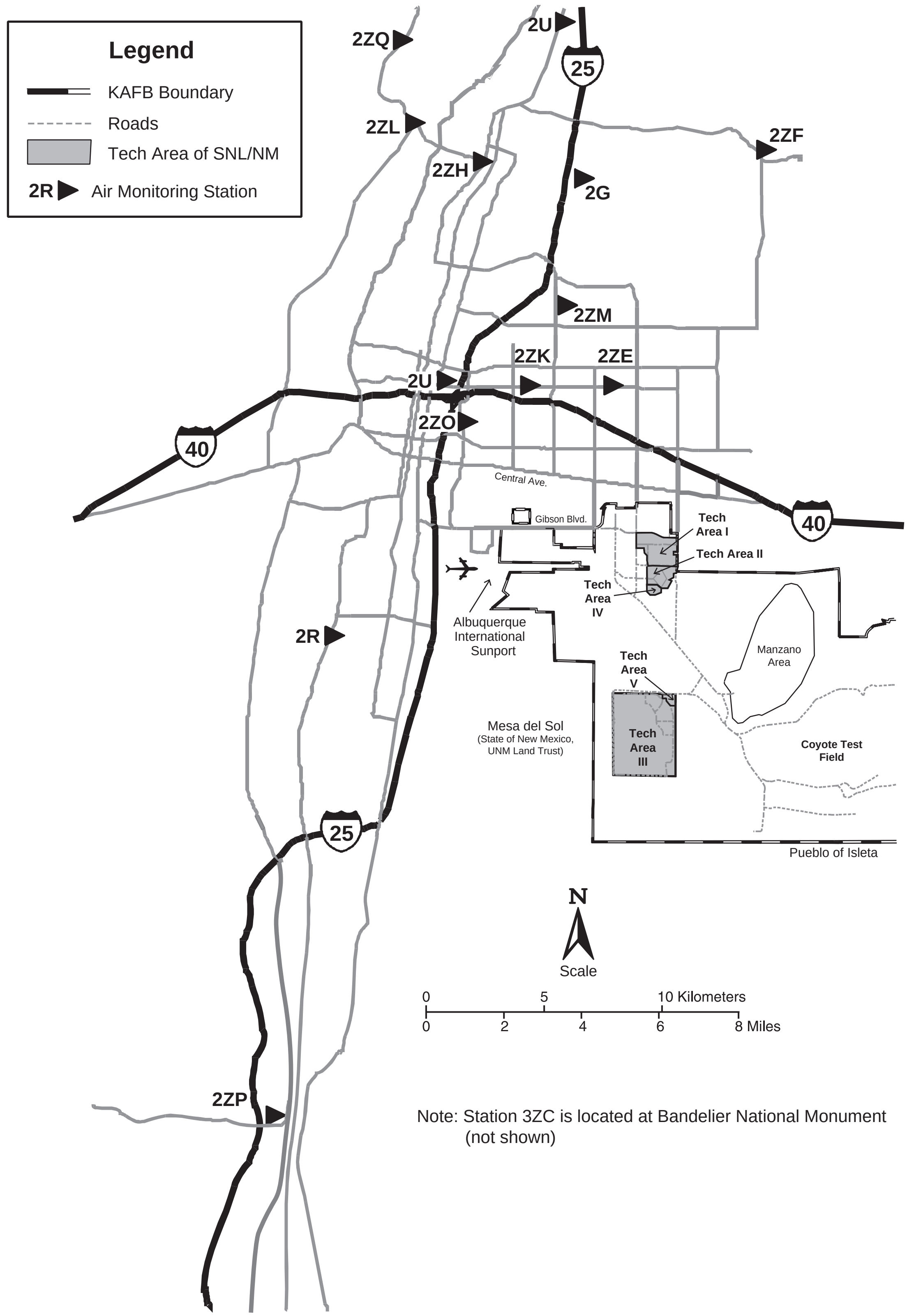
Table 4.9–1 compares maximum air concentrations monitored in the Albuquerque basin during 1996 to applicable Federal (40 CFR Part 50) and state (20 NMAC 2.3) standards for each pollutant. The annual standards are not to be exceeded. Short-term standards may be exceeded, generally once, before a violation must be reported. The preamble of the state regulation (Section 108) allows excesses over short periods of time due to unusual meteorological conditions. Air quality standards were not exceeded in 1996 or 1997 (SNL/NM 1997a).

SNL/NM Air Quality

The major stationary sources of criteria pollutant emissions at SNL/NM are the steam plant, electric power generator plant, and Lurance Canyon Burn Site. Emissions from the steam plant, electric power generator plant, and Lurance Canyon Burn Site include carbon monoxide, nitrogen oxide, sulfur dioxide, and PM_{10}. The emissions factors for the steam plant and electric power generator plant were developed specifically for the SNL/NM operating permit application. The emissions were calculated by using the fuel throughputs provided by SNL/NM and emission factors obtained from the EPA's *Compilation of Air Pollutant Emission Factors-AP–42* (EPA 1995b). Table 4.9–2 summarizes the emissions associated with these facilities for 1992 through 1996, as well as VOC and HAP emissions from the entire site. SNL/NM annual emissions show a trend toward lower annual emissions from 1992 through 1996 for PM_{10}, sulfur dioxide, VOCs, and HAPs. The nitrogen oxide and carbon monoxide emissions fluctuate with the annual demand for steam.

VOC and HAP emissions come from laboratories, miscellaneous chemical operations, and the fire testing facilities. Chemical uses and the corresponding emissions occur in each TA and in the outlying test areas. In 1996, HAP emissions associated with chemical users were 2.4 tons (SNL/NM 1997a). VOC emissions for 1996 were approximately 4.07 tons (SNL/NM 1997a).

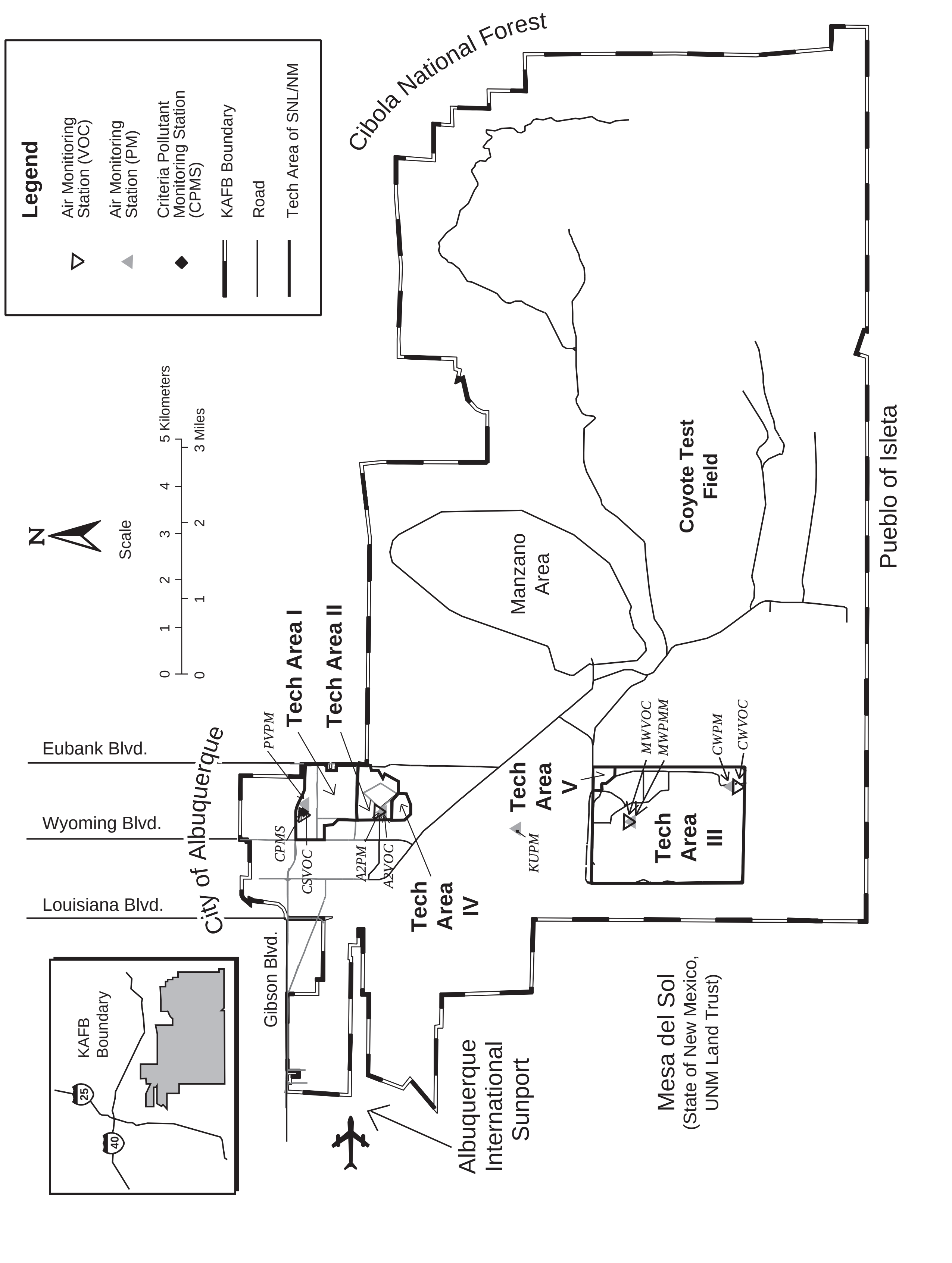
In addition to regional ambient air quality monitoring for criteria pollutants, SNL/NM operates six onsite monitoring stations for PM_{10}. Monitoring results indicate that sampling locations closer to the most populated areas of SNL/NM generally reveal higher PM_{10} concentrations. In addition, PM_{10} concentrations generally increase during



Source: SNL/NM 1997j, 1998f

Figure 4.9–2. Locations of Offsite Criteria Pollutant Monitoring Stations

Fourteen monitoring stations measure criteria pollutants throughout the Albuquerque Basin.



Source: SNL/NM 1997j

Figure 4.9–3. Locations of Onsite Criteria Pollutant Monitoring Stations

Ten ambient air monitoring stations are located within the boundaries of KAFB.

Table 4.9–1. Comparison of 1996 Maximum Ambient Air Concentrations With Applicable National and New Mexico Ambient Air Quality Standards (ppm)

POLLUTANT	AVERAGING TIME	NAAQS	NMAAQS	MAXIMUM AMBIENT AIR CONCENTRATION	MONITORING LOCATION
Carbon Monoxide	8 hours	9	8.7	8.30	2ZK
	1 hour	35	13.1	12.0	2ZK
Lead	Quarterly	1.5[a]	-	0.001[a]	CPMS
Nitrogen Dioxide	Annual	0.053	0.05	0.022	2ZM
	24 hours	-	0.10	0.045	2ZM
Total Suspended Particulates	Annual	-	60[a]	NA	-
	30 days	-	90[a]	NA	-
	7 days	-	110[a]	NA	-
	24 hours	-	150[a]	NA	-
Particulate Matter	Annual	50[a]	-	37[a]	2R
	24 hours	150[a]	-	96[a]	2R
	Annual	0.03	0.02	0.0001	CPMS
Sulfur Dioxide	24 hours	0.14[a]	0.10[a]	0.003[a]	CPMS
	3 hours	0.50[a]	-	0.009[a]	CPMS
Ozone[b]	1 hour	0.12	-	0.111	2ZF
Hydrogen Sulfide	1 hour	-	0.01	NA	-
Total Reduced Sulfur	0.5 hour	-	0.03	NA	-

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
CPMS: Criteria Pollutant Monitoring Station
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million
[a] micrograms per cubic meter
[b] New 8-hour, 0.08-ppm ozone standard, applicable to SNL/NM, will apply in year 2000 (see Section 4.9.1.1).

Table 4.9–2. Estimated Air Emissions from Stationary Sources at SNL/NM, 1992 through 1996 (tons/year)

POLLUTANT	SOURCE	1992	1993	1994	1995	1996
Nitrogen Oxide	Lurance Canyon Burn Site[c]	0.07	0.02	0.02	0.02	0.02
	Steam plant	47.78[a]	155.08[b]	148.06[b]	126.00[b]	153.00[b]
	Building 862 generators	0.03	5.55	0.61	1.11	0.90
	TOTAL	**47.88**	**160.65**	**148.69**	**127.13**	**153.92**
Carbon Monoxide	Lurance Canyon Burn Site[c]	2.87	0.77	0.79	0.75	0.78
	Steam plant	4.44[a]	16.25[b]	15.60[b]	13.80[b]	14.20[b]
	Building 862 generators	0.00	0.28	0.02	0.29	0.23
	TOTAL	**7.31**	**17.3**	**16.41**	**14.84**	**15.21**
PM_{10}	Lurance Canyon Burn Site[c]	2.60	0.70	0.71	0.69	0.71
	Steam plant	1.76[a]	3.90[b]	3.75[b]	3.45[b]	2.93[b]
	Building 862 generators	0.00	0.93	0.02	0.02	0.01
	TOTAL	**4.36**	**5.53**	**4.48**	**4.16**	**3.65**
Sulfur Dioxide	Lurance Canyon Burn Site[c]	0.14	0.04	0.04	0.04	0.04
	Steam plant	2.12[a]	0.33[b]	0.26[b]	0.22[b]	0.22[b]
	Building 862 generators	0.00	0.87	0.13	0.08	0.06
	TOTAL	**2.26**	**1.24**	**0.43**	**0.34**	**0.32**
VOCs	All facilities	NA	63.32	24.00	9.8	4.07
HAPs	All facilities	NA	50.75	17.79	5.52	2.4

Source: SNL/NM 1997a
HAPs: hazardous air pollutants
NA: not available
PM_{10}: particulate matter less than 10 microns in diameter
SMERF: Smoke Emission Reduction Facility
SNL/NM: Sandia National Laboratories/New Mexico
SWISH: Small Wind-Shielded Facility
VOCs: volatile organic compounds
[a] Based on actual stack emission measurements
[b] Based on published, theoretical emission factors in EPA AP-42
[c] Fire testing facilities include a number of open pools, the SMERF, and the SWISH located in Lurance Canyon

the windy season due to blowing soil particles. Dry weather conditions enhance this trend of increased concentration during windy periods. Table 4.9–3 presents the criteria pollutant concentrations at monitoring stations in TA-I. These stations measure concentrations of criteria pollutants from the nearest SNL/NM emission sources.

In 1996, VOC samples were collected at four onsite monitoring stations. These locations were selected for their proximity to known VOC emission sources. Table 4.9–4 presents the estimated 8-hour concentrations of VOCs calculated from onsite monitoring data for 1996 and the respective 8-hour OELs. These data are presented for comparison and indicate that the concentrations of VOCs measured at the onsite monitors are well below the respective OEL concentrations for an 8-hour workday.

The monitored VOCs represent a portion of the total chemical emissions from SNL/NM facilities. Monitoring data are not available for additional chemical compounds.

Steam Plant

The steam plant produces heat for buildings in TA-I and the eastern portion of KAFB. During 1996, all five boilers at the plant used a total of 740 M standard ft^3 of natural gas. These boilers can also run on diesel oil and used approximately 15,000 gal of oil during 1996 for system testing. Criteria pollutant emissions for 1992 through 1996 for the steam plant are presented in Table 4.9–2. The annual emissions for each pollutant vary from year to year based upon the heating degree days, fuel mix (natural gas versus fuel oil), and plant boiler loading, which have different efficiencies at different loadings.

Electric Power Generator Plant

SNL/NM has four standby generators, each with a 600-kW capacity. These diesel-fired generators are in TA-I, Building 862. The generators have a local air quality permit limiting operation to 500 hours per year per generator. They are started monthly for maintenance and testing, as well as during electrical power outages in TA-I.

Fire Testing Facilities (Lurance Canyon Burn Site)

The fire testing facilities (Lurance Canyon Burn Site) include a number of open pools, the Smoke Emission Reduction Facility (SMERF), and the Small Wind-Shielded (SWISH) Facility. The open pools emit directly to the atmosphere, while SMERF and SWISH are closed and emit through exhaust stacks. The fire testing facilities are used to test the response of shipping containers, aerospace components, and other items to high-temperature conditions. These facilities use a variety of fuels including jet fuel (JP-8), sawdust, a sawdust-propellant-acetone (SPA) mixture, explosives, and urethane foam.

These facilities typically average 42 tests per year; each test lasts about 30 minutes, although some can last as long as 4 hours. During 1996, the fire testing facilities used 10,400 gal of JP-8 and approximately 8 tons of sawdust (or wood). Based on process knowledge, emissions from these tests are known to include carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, and chemical pollutants (SNL/NM 1997a).

Mobile (Vehicular) Sources

Mobile sources (motor vehicles) are a major source of criteria pollutant emissions in and around SNL/NM. Carbon monoxide levels are the highest from November through January (MRGCOG 1997c). The EPA's *Mobile Source Emission Factor* computer model, *MOBILE5a* (EPA 1994), showed an estimated 920 tons of carbon monoxide emissions from SNL/NM commuter traffic for November through January (SNL 1996c), which is approximately 3.7 percent of the estimated carbon monoxide emissions for Bernalillo county vehicular emissions during the same period. Total SNL/NM mobile source carbon monoxide emissions for 1996 are 4,087 tons. For more information on the number of vehicles, see Volume II, Table D.1–30.

4.9.2 Radiological Air Quality

4.9.2.1 Definition of Resource

Specific SNL/NM facilities discharge low quantities of radionuclides to the air. These releases can be evaluated according to the individual and population dose created from the combined releases of all facilities at SNL/NM. The degree of hazard to the public is directly related to the type and quantity of the radioactive materials released. How long a person is exposed to the released material is also a factor in assessing potential health effects. Dose estimates are modeled from emissions determined at each facility and compared to regulatory dose limits for the protection of public health.

4.9.2.2 Region of Influence

The ROI is the 50-mi radius of SNL/NM, which is consistent with the recommended DOE 5400.5 guidance. The ROI includes the counties of Bernalillo, McKinley, Cibola, San Miguel, Santa Fe, Sandoval, Valencia, Socorro, and Torrance, and the major cities of Albuquerque and Rio Rancho.

Table 4.9–3. 1996 Criteria Pollutant Concentrations from the Criteria Pollutant Monitoring Station with Applicable National and New Mexico Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	NAAQS (ppm/$\mu g/m^3$)	NMAAQS (ppm/$\mu g/m^3$)	BASELINE CONCENTRATION (ppm/$\mu g/m^3$)	PERCENT OF STANDARD
Carbon Monoxide	8 hours	9/8,564	8.7/8,279	2.86/2,722	33
	1 hour	35/33,305	13.1/12,466	8.30/7,898	63
	Annual	-	-	0.78/742	NA
Lead	30 days	-	-	0.0021[a]	NA
	Quarterly	1.5[a]	-	0.001[a]	0.07
Nitrogen Dioxide	Annual	0.053/83	0.05/78	0.012/19	24
	24 hours	-	0.10/156	0.035/55	35
Particulates (TSP)	Annual	-	60[a]	14.76[a]	30
	30 days	-	90[a]	NA	NA
	7 days	-	110[a]	NA	NA
	24 hours	-	150[a]	49[a]	33
Particulate Matter (PM_{10})	Annual	50[a]	-	14.76[a,b]	30
	24 hours	150[a]	-	49[a,b]	33
Sulfur Dioxide	Annual	0.03/65	0.02/44	0.0003/0.7	1.5
	24 hours	0.14/305	0.10/218	0.003/6.5	3
	3 hours	0.50/1,088	-	0.009/20	2
Ozone	Annual	-	-	0.033/54	NA
	1 hour	0.12/196	-	0.103/168	85.8
Hydrogen Sulfide	1 hour	-	0.01/12	NA	NA
Total Reduced Sulfur	0.5 hour	-	0.03/33	NA	NA

Sources: 20 NMAC 2.3, 40 CFR Part 50, SNL/NM 1997a
- indicates no standard for listed averaging time
°R: degrees Rankin
CPMS: Criteria Pollutant Monitoring Station
ft: feet
NA: not available
NAAQS: National Ambient Air Quality Standard
NMAAQS: New Mexico Ambient Air Quality Standard
ppm: parts per million
TSP: total suspended particulates
[a] micrograms per cubic meter
[b] highest quarterly lead monitoring data measured at the CPMS site in 1996
[c] highest one hour ozone monitoring data measured at the CPMS in 1996
[d] PM_{10} is assumed equal TSP
Note: Some of the pollutants are stated in parts per million (ppm). These values were converted to micrograms per cubic meter ($\mu g/m^3$) with appropriate corrections for temperature (530°R) and pressure (elevation 5,400 ft) following New Mexico dispersion modeling guidelines (revised 1996).

Table 4.9–4. Maximum Ambient Concentrations of Volatile Organic Compounds from Onsite Monitors for 1996

VOCS	ESTIMATED 8-HOUR CONCENTRATION[a] (ppb)	8-HOUR OEL[b] (ppb)
1,1,1-trichloroethane	134.235	348,000
1,4-dioxane+2,2,4-trimethylpentane	1.35	25,000
1-butene	0.741	NA
2,2,4-trimethylpentane	0.426	NA
3-methylpentane	0.765	NA
Acetone	20.025	250,000
Benzene	1.674	100
Bromodichloromethane	0.096	NA
Carbon Tetrachloride	0.357	5,000
Chloromethane	1.371	5,000
Dichlorodifluoromethane	1.887	1,000,000
Ethylbenzene	0.411	100,000
Halocarbon 113	0.291	NA
Isobutene	0.648	NA
Isobutene + 1-butene	1.2	NA
Isohexane	1.425	NA
Isopentane	5.526	120,000
m/p-xylene	0.897	100,000
Methylene Chloride	0.258	50,000
n-Butane	5.466	800,000
n-Hexane	0.831	50,000
n-Pentane	2.496	120,000
n-Undecane	0.219	NA
o-Xylene	0.435	100,000
Tetrachloroethene	0.126	NA
Toluene	3.117	50,000
Trichloroethene	0.366	NA
Trichloroethene+Bromodichloromethane	0.195	NA
Trichlorofluoromethane	0.831	1,000,000
Total Nonmethane Hydrocarbons	259.191	NA

Source: SNL/NM 1997a
NA: not available
OEL: occupational exposure limit
ppb: parts per billion
VOC: volatile organic compound
[a] Estimated value calculated by multiplying the 24-hour measured concentration by 3.
[b] OELs are the minimum time-weighted exposure concentration for an 8- or 10-hour workday and a 40-hour work week to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect based upon the following sources:
American Conference of Governmental Industrial Hygienists
U.S. Occupational Safety and Health Administration
National Institute of Occupational Safety and Health
Deutsche Forschungsgemeinschaft (DFG), Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area

4.9.2.3 Affected Environment

Data from 1992 through 1996 were reviewed to characterize the baseline operational radiological emissions and corresponding dose estimates for specific SNL/NM facilities. The sources of this data were annual NESHAP reports, annual surveillance/monitoring reports, existing site environmental descriptions, radioactive emissions, and dose evaluations.

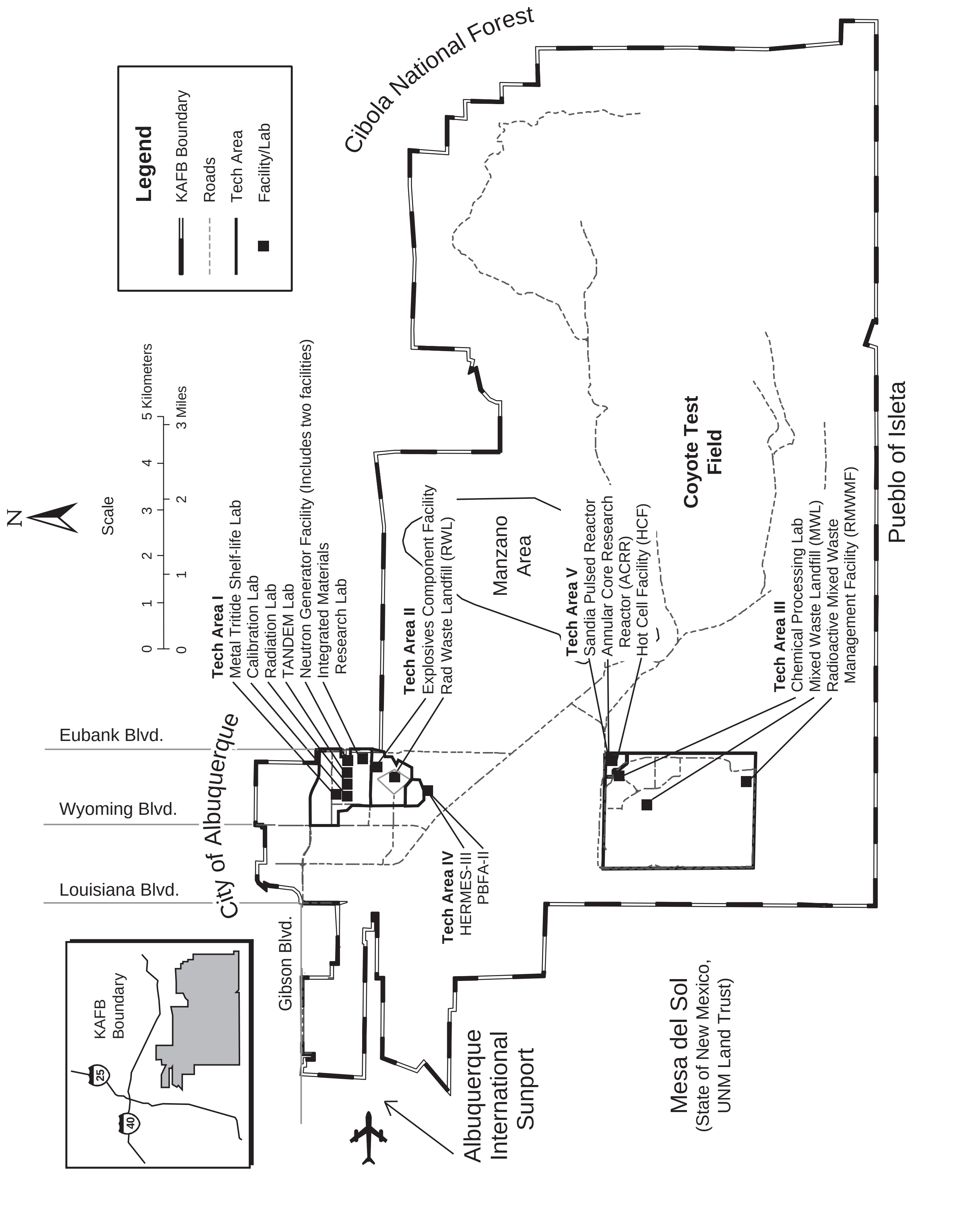
SNL/NM facilities that release radionuclides are shown in Figure 4.9–4. Table 4.9–5 identifies the types and quantities of radionuclides released from these facilities from 1993 through 1996. The 1992 estimated radiological emissions data and doses were not included in this baseline due to large variations in the data. These releases were used to calculate the doses at various receptors, thereby identifying a maximally exposed individual (MEI) member of the public and also the dose to the total population (732,823) within 50 mi of SNL/NM.

Because the general public (such as visitors to the golf course or National Atomic Museum) and Air Force personnel (such as families at base housing) have access to SNL/NM, both onsite and site boundary locations are considered as potential locations for an MEI. Table 4.9–6 presents the total dose to the MEI, along with the dose contributions from each facility for each year's radionuclide emissions, which are calculated using the *Clean Air Assessment Package* (*CAP88-PC)* computer model (DOE 1997e). These calculated doses are less than the regulatory limit of 10 mrem/yr of exposure to an individual of the public from airborne releases of radiological materials (40 CFR Part 61). These doses also are small compared to an individual background radiation dose of 360 mrem/yr (Section 4.10.3).

> **Maximally Exposed Individual**
>
> A hypothetical person at a location who could potentially receive the maximum dose of radiation or hazardous chemicals.

Both the dose to the MEI and the collective dose to the entire population within 50 mi of SNL/NM were assessed. Although releases from separate facilities contribute to the collective population dose, the computer model evaluated emissions out to a 50-mi radius, based on a single common release point centered at TA-V. The distances between buildings are relatively small compared to 50 mi, therefore, dose estimate results were only minimally affected. The calculated collective doses for SNL/NM operations from 1993 through 1996 are presented in Table 4.9–6.

Looking at the trend in SNL/NM radiological air emissions, higher releases occurred in 1996 than in the years 1993 through 1995 (Table 4.9–5). This has been attributed to converting and refurbishing the Annular Core Research Reactor (ACRR) for medical isotope production. Also, NESHAP "confirmatory measurements" requirements for radioactive air emissions were instituted at the Sandia Pulsed Reactor (SPR) and ACRR; these measurements were higher than calculated emissions. Since the SWEIS is addressing potential impacts for projected and planned future operations, the 1996 operations are considered representative of radiological air emissions for characterizing future SNL/NM operations. It can be seen from Table 4.9–5, that MEI dose is dominated by SPR, ACRR, and HCF source emissions.



Source: SNL/NM 1997d

Figure 4.9–4. SNL/NM Radionuclide-Releasing Facilities

Radionuclide-releasing facilities are located in all five technical areas.

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR 1993	1994	1995	1996
Sandia Pulsed Reactor, Building 6590	TA-V	Point	Argon-41	0.48	0.55	1.7	9.51
Annular Core Research Reactor, Building 6588	TA-V	Point	Argon-41	2.70	2.1	3.0	35.4
Hot Cell Facility, Building 6580	TA-V	Point	Tritium	0	$1.1x10^{-5}$	$2.0x10^{-5}$	0
			Iodine-131	0	0	0	$1.96x10^{-3}$
			Iodine-132	0	0	0	$1.29x10^{-4}$
			Iodine-133	0	0	0	$9.51x10^{-3}$
			Iodine-135	0	0	0	$1.32x10^{-3}$
			Krypton-83m	0.068	0.017	0.016	$9.57x10^{-5}$
			Krypton-85	$3.7x10^{-6}$	$5.7x10^{-6}$	$3.3x10^{-5}$	$1.53x10^{-3}$
			Krypton-85m	0.14	0.063	0.12	0.587
			Krypton-87	0.17	0.032	0.0014	0.0294
			Krypton-88	0.36	0.11	0.10	0.527
			Rubidium-86	$1.1x10^{-7}$	$1.5x10^{-7}$	$8.0x10^{-7}$	0
			Rubidium-87	$1.0x10^{-14}$	$1.4x10^{-14}$	$8.1x10^{-14}$	0
			Rubidium-88	0.41	0.019	$4.1x10^{-4}$	0
			Rubidium-89	0.0011	$4.8x10^{-5}$	0	0
			Xenon-131m	$5.7x10^{-6}$	$5.8x10^{-4}$	$5.7x10^{-5}$	$3.45x10^{-4}$
			Xenon-133	0.026	0.034	0.24	17.5
			Xenon-133m	0.0013	0.0017	0.011	0.768
			Xenon-135	0.40	0.41	1.4	14.7
			Xenon-135m	0.18	0.0051	$2.7x10^{-4}$	0.976
			Xenon-137	0	$2.2x10^{-27}$	0	0
			Xenon-138	0.0019	$1.4x10^{-4}$	$1.4x10^{-14}$	0
High-Energy Radiation Megavolt Electron Source, Building 970	TA-IV	Point	Nitrogen-13	0.58	2.32	$5.5x10^{-4}$	$2.85x10^{-4}$
			Oxygen-15	0.0050	0.030	$5.5x10^{-5}$	$2.85x10^{-5}$
Particle Beam Fusion Accelerator Building	TA-IV	Point	Nitrogen-13	0.042	0.042	0.042	0.042
			Oxygen-15	0.0050	0.0050	0.005	0.005
Mixed Waste Landfill	TA-III	Diffuse	Tritium	1.9	0.29	0.29	0.29

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (continued)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Chemical Processing Laboratory, Building 6600	TA-III	Point	Na-22	0	$2.4x10^{-12}$	$2.4x10^{-12}$	$2.4x10^{-12}$
			Gadolinium-153	0	$1.0x10^{-13}$	0	0
			Americium-241	0	$1.0x10^{-13}$	$1.0x10^{-13}$	$1.0x10^{-13}$
			Uranium-232	0	0	$1.0x10^{-13}$	$1.0x10^{-13}$
			Plutonium-241	0	0	$1.0X10^{-13}$	$1.0x10^{-13}$
Radioactive and Mixed Waste Management Facility, Building 6920	TA-III	Point	Tritium	0	0	0	4.12
Radioactive Waste Landfill	TA-II	Diffuse	Americium-241	0	0	0	$4.7x10^{-13}$
			Plutonium-239/240	0	0	0	$3.9x10^{-15}$
			Plutonium-238	0	0	0	$7.9x10^{-15}$
Explosive Components Facility, Building 905	TA-II	Point	Tritium	0	0	0	$7.0x10^{-4}$
Integrated Materials Research Laboratory, Building 897	TA-I	Point	Carbon-14	0	0	0	$2.21x10^{-5}$
Neutron Generator Facility, Building 870	TA-I	Point	Tritium	0	0	0	0.11
TANDEM Accelerator, Building 884	TA-I	Point	Tritium	0	0	0	$1.0x10^{-6}$
			Carbon-11	$4.2x10^{-5}$	$5.2x10^{-5}$	$8.8x10^{-6}$	$5.3x10^{-3}$
			Nitrogen-13	$9.9x10^{-5}$	$1.2x10^{-4}$	$2.1x10^{-5}$	$9.3x10^{-8}$
			Oxygen-14	0	$3.2x10^{-7}$	$5.3x10^{-8}$	0
			Oxygen-15	0.0017	0.0021	0.00035	0.021
			Fluorine-17	0	$8.0x10^{-6}$	$1.3x10^{-6}$	$8.0x10^{-4}$
			Fluorine-18	$9.4x10^{-6}$	$1.2x10^{-5}$	$2.0x10^{-6}$	$4.4x10^{-5}$

Table 4.9–5. Summary of Radionuclides Released from SNL/NM Operations from 1993 through 1996 (concluded)

SOURCE LOCATION	TA	TYPE	RADIONUCLIDE RELEASED[a]	CURIES/YR			
				1993	1994	1995	1996
Radiation Laboratory, Building 827 & Building 805	TA-I	Point	Tritium	1.0×10^{-5}	1.0×10^{-5}	2.0×10^{-5}	1.00×10^{-5}
			Nitrogen-16	0	2.0×10^{-7}	2.0×10^{-7}	2.00×10^{-7}
			Nitrogen-17	0	0	1.0×10^{-8}	0
			Nitrogen-13	1.0×10^{-8}	1.0×10^{-8}	0	1.0×10^{-8}
			Nitrogen-15	0	0.10	0	0
			Argon-41	1.0×10^{-9}	1.0×10^{-9}	1.0×10^{-9}	1.00×10^{-9}
			Carbon-13	0	0.20	0	0
			Carbon-14	2.0×10^{-12}	2.0×10^{-12}	2.0×10^{-12}	0
			Curium-244	7.0×10^{-11}	7.0×10^{-11}	0	0
			Lead-210	4.0×10^{-13}	4.0×10^{-13}	0	0
			Uranium-238	4.0×10^{-12}	4.0×10^{-12}	0	0
			Plutonium-239	6.0×10^{-12}	6.0×10^{-12}	0	0
			Americium-241	1.0×10^{-11}	1.0×10^{-11}	0	0
Metal Tritide Shelf-Life Laboratory, Building 891	TA-I	Point	Tritium	6.0×10^{-5}	6.0×10^{-5}	5.0×10^{-9}	5.0×10^{-9}
Calibration Laboratory, Building 869	TA-I	Point	Tritium	0	1.5×10^{-6}	3.7×10^{-5}	2.51×10^{-4}
Neutron Generator Testing Facility, Building 935	TA-I	Point	Tritium	0	0	2.8×10^{-5}	0

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
SNL/NM: Sandia National Laboratories/New Mexico
TA: technical area
yr: year
[a] Historical releases do not necessarily equate to projected releases presented in Sections 5.3.7.2, 5.4.7.2, and Appendix D.2. This is due in part to DOE project and program changes expected through 2008.

Table 4.9–6. Summary of Dose Estimates to SNL/NM Public from Radioactive Air Emissions (1993 to 1996) Modeled Effective Dose Equivalent (mrem/yr) to SNL/NM MEI and (person-rem) to Population

SOURCE	YEAR			
	1993	1994	1995	1996
MEI (mrem/yr)				
Sandia Pulsed Reactor, Building 6590	$5.9x10^{-5}$	$[5.0x10^{-4}]$[a]	$2.5x10^{-4}$	$1.2x10^{-3}$
Annular Core Research Reactor, Building 6588	$1.6x10^{-3}$		$6.0x10^{-4}$	$5.4x10^{-3}$
Hot Cell Facility, Building 6580	-	-	-	$3.9x10^{-4}$
High-Energy Radioactive Megavolt Electron Source	$1.7x10^{-5}$	$2.9x10^{-5}$	$5.8x10^{-9}$	$2.0x10^{-9}$
Particle Beam Fusion Accelerator, Building 983	$1.2x10^{-6}$	0	$4.0x10^{-7}$	$3.3x10^{-7}$
Mixed Waste Landfill	$8.5x10^{-6}$	$5.0x10^{-6}$	$4.0x10^{-6}$	$4.0x10^{-6}$
Chemical Processing Laboratory, Building 6600	-	$1.3x10^{-11}$	$3.7x10^{-11}$	$3.2x10^{-11}$
Radioactive and Mixed Waste Management Facility, Building 6920	-	-	-	$1.4x10^{-5}$
Radioactive Waste Landfill	-	-	-	$7.6x10^{-12}$
Explosive Components Facility, Building 905	-	-	-	$3.1x10^{-9}$
Integrated Materials Research Laboratory, Building 897	-	-	-	$4.8x10^{-12}$
Neutron Generator Facility, Building 870	-	-	-	$4.7x10^{-8}$
TANDEM Accelerator, Building 884	$2.7x10^{-9}$	$1.2x10^{-9}$	$3.0x10^{-10}$	$4.5x10^{-8}$
Radiation Laboratory, Building 827 & Building 805	$2.8x10^{-9}$	$8.8x10^{-10}$	$2.9x10^{-10}$	$4.6x10^{-11}$
Metal Tritide Shelf-Life Laboratory, Building 891	$1.0x10^{-9}$	$1.9x10^{-10}$	$3.0x10^{-14}$	$1.8x10^{-14}$
Calibration Laboratory, Building 869	-	$7.7x10^{-12}$	$5.7x10^{-10}$	$1.2x10^{-9}$
Neutron Generator Test Facility, Building 935	-	-	$2.1x10^{-9}$	-
TOTAL	**$1.6X10^{-3}$**	**$5.3X10^{-4}$**	**$8.5X10^{-4}$**	**$7.0X10^{-3}$**
Collective Dose (person-rem) for Population Within 50 Miles Population Dose, person-rem	0.026	0.012	0.016	0.14

Sources: SNL 1994b, 1995c, 1996a, 1997d
- concentration not measured or facility inactive
MEI: maximally exposed individual
mrem/yr: millirems per year
SNL/NM: Sandia National Laboratories/New Mexico
[a] Dose total for Sandia Pulsed Reactor and Annular Core Research Reactor

4.10 HUMAN HEALTH AND WORKER SAFETY

4.10.1 Definition of Resource

This section on human health and worker safety describes how existing physical and environmental conditions affect public health and worker health and safety. It includes all individuals who could be affected by radioactive and nonradioactive hazardous materials released from SNL/NM operations. These individuals are referred to as receptors.

This section compares SNL/NM worker health and safety performance records from 1992 to 1996 to equivalent national, regional, or local health statistics. The current relationship of people to the SNL/NM environment is assessed by resource area. These assessments constitute the framework for understanding the impacts from the alternatives presented in Chapter 5.

4.10.2 Region of Influence

For a human to be exposed to a released material, there must be both complete transport and exposure pathways (Figure 4.10–1). Since pathways differ, the ROI for assessing health impacts to people in and around SNL/NM is specific to each exposure pathway. The ROIs for impacts to public health from radiological and nonradiological air emissions are the population living and working within 50 mi and 15 mi of SNL/NM, respectively. The ROIs for impacts to public health from pathways associated with groundwater, soils, and surface water relate more to the physical extent of that resource (such as the extent of groundwater used for drinking by the city of Albuquerque, discussed in Section 4.6.2).

4.10.3 Affected Environment

The environment within the ROI includes environmental resources such as air, groundwater, and soil, which, if affected, could subsequently affect public health and worker health and safety. See the specific resource sections for descriptions of existing conditions for these resources.

Any environmental releases due to activities described in the SWEIS have the potential to affect the health of people who live around and work at SNL/NM. Specifically, the SWEIS addresses the effects of radiation from radiological materials and the effects of hazardous materials on human health, as well as occupational safety issues common to laboratory and industrial work sites.

4.10.3.1 National and Regional Health Information

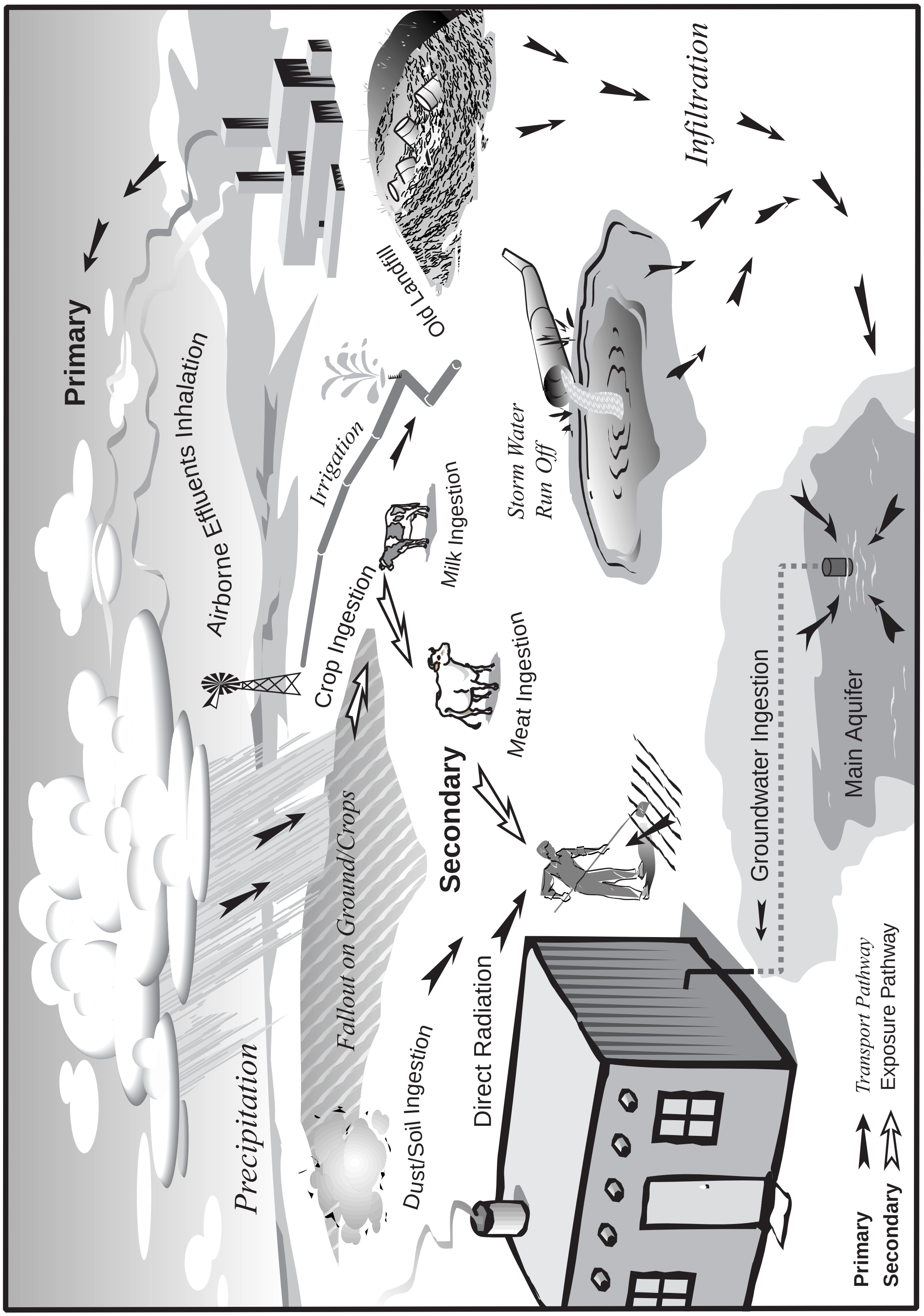
The general health of the population within the U.S., based on the types and rates of cancer, is assessed annually by the American Cancer Society (ACS). In the U.S., men have a 1 in 2 lifetime risk of developing cancer; for women, the risk is 1 in 3. The National Cancer Institute estimates that approximately 7.4 M Americans alive today have a history of cancer and that one out of every four deaths in the U.S. is from cancer (ACS 1997a).

The ACS annually estimates the number of cancer deaths and the number of new cancer cases nationally and by state. Nationally, the estimated 1997 cancer mortality rate was 173 deaths per 100,000 persons; for New Mexico, the rate was 146 per 100,000 persons. The estimated 1997 number of new cancer cases likely to occur in the U.S. was 1.4 M, with 7,000 occurring in New Mexico (excluding skin cancer cases). Estimates were based on 1997 population growth estimates.

The DOE has developed various programs and data collection/tracking systems that can be analyzed for epidemiological trends or for epidemiological studies by independent agencies or individuals. The DOE Office of Epidemiological Surveillance Program tracks the illnesses and injuries (incidence rates) of more than 65,000 DOE workers. SNL/NM has electronically coded and archived over 10 years of employee health information through this program. The database gives epidemiologists the opportunity to analyze health events that have affected the SNL/NM workforce over an extended time. The archived information has been categorized and summarized in the DOE *1993 Epidemiologic Surveillance Report* (DOE n.d. [b]).

Transport and Exposure Pathways

The pathways that release materials to the environment and subsequently reach people are known as transport and exposure pathways. A *transport pathway* is the environmental medium, such as groundwater, soils, or air, by which a contaminant is moved (for example, chemicals carried in the air or dissolved in groundwater and moved along by wind or groundwater flow). An *exposure pathway* is how a person comes into contact with the contaminant, for example, breathing (inhalation), drinking water (ingestion), or skin contact (dermal).



Source: Original

Figure 4.10–1. Transport and Exposure Pathways

For a human to be exposed to a released material, there must be both complete transport and complete exposure pathways.

These studies document health conditions of the worker population in general, but do not assess the effects of specific chemicals or radiation doses from SNL/NM operations on human health. Therefore, the health effects data are not associated with specific SNL/NM operations, environmental releases, or worker or public exposures to hazardous or radioactive materials.

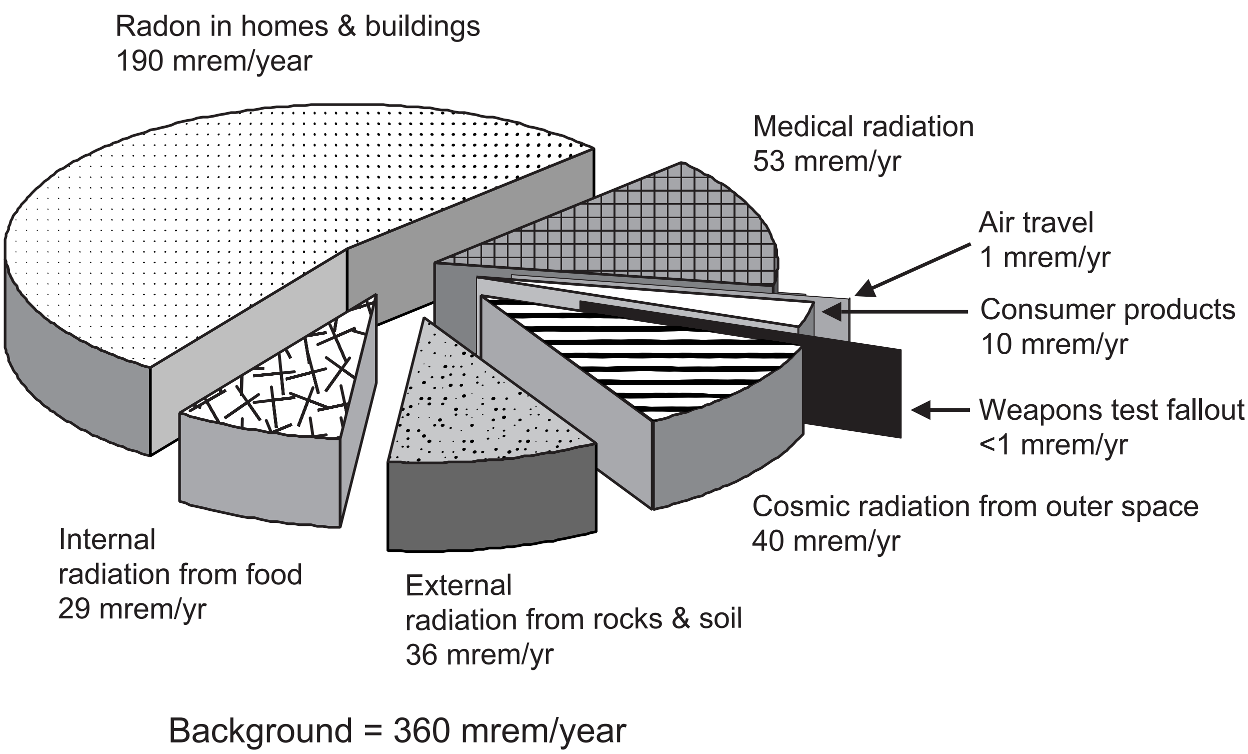
4.10.3.2 Public Health

Radiological and nonradiological hazardous materials released from SNL/NM facilities reach the environment and people through different transport pathways. The SWEIS focuses on transport media associated with inhalation, ingestion, or direct contact exposure pathways, such as air and drinking water, because they are the ways in which the greatest amount of a pollutant can reach people. The SWEIS evaluates the possibility of collective effects due to multiple pathways and indirect pathways for any impact contribution.

Radiological

Figure 4.10–2 presents major sources and levels of background radiation exposure to individuals in the vicinity of SNL/NM (SNL 1997d). All annual doses to individuals from background radiation are practically constant over time. The collective dose to the population varies as a result of increases or decreases in population size. The background radiation dose of 360 mrem/yr is unrelated to SNL/NM operations.

Air releases of radionuclides from the operation of a specific facility at SNL/NM result in radiation exposures to people in its vicinity. The radiation dose is calculated annually based on actual facility emissions monitoring data. Table 4.9–6 shows radiation doses from 1993 through 1996 for maximally exposed individual members of the public at SNL/NM. Based on the risk estimator of 500 fatal cancers per 1 M person-rem (ICRP 1991) to the public, a person exposed to the greatest amount of these SNL/NM radiological air releases would have an



Sources: NCRP 1987, SNL 1997d
mrem/yr: millirems per year

Figure 4.10–2. Major Sources and Levels of Background Radiation Exposure in the SNL/NM Vicinity

The total annual background dose of radiation to an individual in the vicinity of SNL/NM is 360 millirem.

Calculating Radiological Effects

Estimating potential human health effects involves a series of calculations that indicate the potential health consequence of a particular action or accident. Effects can be calculated both for individuals and for a population. The health effect of concern is a person dying from cancer caused by being exposed to low levels of radiation. To quantify the radiological impact, the radiation dose must be calculated.

The dose is a function of the exposure pathway (external, inhalation, or ingestion) and the type and quantity of radionuclides involved. The calculated concentrations of radionuclides in the air from emissions are used in conjunction with uptake parameters, usage rates, duration times, and radionuclide-specific dose factors in determining internal dose. The total dose is the sum of external and internal doses from all pathways.

After the dose is estimated, the health impacts (number of additional latent cancer fatalities in a population or probability of additional latent cancer fatalities for an individual) are calculated from current internationally recognized risk factors (Section 4.10.3). These health impacts are further explained in Section 4.10.

annual increased risk of dying from cancer of 3.5×10^{-9}. In other words, the likelihood of this person dying of cancer because of the maximum 1-year dose from SNL/NM operations is less than 4 chances in 1 B. This annual release has the potential to increase the number of latent cancer fatalities in the entire population within 50 mi of SNL/NM by 7.0×10^{-5}.

Radiological contamination contained in other environmental resources affected by SNL/NM has the potential to reach the public by different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water are designed to monitor and assess the potential for public exposures to these pollutants through these different media.

Radiation exposures are not expected through surface water, soils, groundwater, and natural vegetation, based on information in the SNL/NM *1996 Site Environmental Report* (SNL 1997d). Data collected from environmental sampling show that these media do not present complete exposure pathways that connect SNL/NM to the general population. The public, therefore, is not in contact with radiological pollutants from these media.

Nonradiological

Nonradiological chemical air pollutants are released from SNL/NM facilities that house chemistry laboratories or chemical operations. Air samples collected near known chemical emission sources are presented as the highest expected chemical air pollutant levels from current SNL/NM operations. Due to dilution and dispersion, lower levels of these air pollutants would occur at locations offsite and further away from the sources.

The maximum ambient concentrations of VOCs measured by monitoring stations onsite at SNL/NM in 1996 are identified in Table 4.9–4 (SNL/NM 1997a). These concentrations are below safety levels established for workers in industrial areas. Although there are no SNL/NM-operated monitoring stations offsite, it is possible to make the assessment that concentrations decrease with distance from the source and, therefore, are also below health-risk levels for impacts to public health.

Small amounts of nonradiological chemical contamination, which have been caused by past SNL/NM operations, have been identified in other environmental resources (such as groundwater and soils-subsurface [Sections 4.5 and 4.6]). Chemicals existing in the environment have the potential to reach members of the public through these different transport pathways. Environmental sampling programs involving resources such as groundwater, soils, and surface water, are designed to monitor and assess the potential for public exposure to these pollutants through these different media. Evaluations of groundwater, soils, and surface water information indicate that the public is not in contact with these areas of contamination within SNL/NM site boundaries and that the contamination is not being transported offsite (Sections 4.5.3, 4.6.3, and 4.6.6).

4.10.3.3 Worker Health and Safety

SNL/NM operations are required to be in compliance with the DOE and Occupational Safety and Health Administration (OSHA) requirements for worker health and safety. DOE ES&H programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries.

Radiological

SNL/NM's Occupational Radiation Protection Program complies with the Federal requirements in 10 CFR Part 835, *Occupational Radiation Protection*, and DOE N 441.1, *Radiological Protection for DOE Activities*. These requirements provide protection to onsite workers and visitors at SNL/NM.

Workers receive approximately the same background radiation dose as members of the general public. Some workers receive an additional dose from working in specific radiation facilities. The Sandia Dosimetry System (SANDOS) database records worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. Summary information is then provided to the DOE's Radiation Exposure Monitoring System (REMS) database. Radiation monitoring devices, known as dosimetry badges, report an individual's external dose information. Bioassays provide internal dose information. Annually, information from dosimetry badges and bioassays is totaled as an individual TEDE and provided to each worker.

The SANDOS and REMS databases also contain information on the number of badges issued. This is used to compile the annual average dose to workers at SNL/NM. Because the reporting limit used to assess dosimetry badges is 10 mrem (external and internal radiation dose) above background, only exposures greater than or equal to 10 mrem above background are used in deriving the annual average collective TEDE to workers. For purposes of the SWEIS, this annual average collective TEDE is applied to this group of workers characterized as radiation-badged workers (badges with greater than 10 mrem). The actual annual average worker dose for the entire SNL/NM workforce is much lower than the annual average radiation-badged worker dose.

Table 4.10–1 lists the annual average, maximum, and collective radiation-badged worker doses, based on data for 1992 through 1996. Based on the International Commission on Radiation Protection (ICRP 1991)-recommended risk estimator of 400 fatal cancers per 1 M person-rem among workers (ICRP 1991), the annual average collective dose increases the number of additional fatal cancers by $4.8x10^{-3}$ in the radiation-badged worker population from routine SNL/NM operations. The annual average radiation-badged worker dose (based on the 5-year average) increases the radiation-badged worker's lifetime risk of fatal cancer from a one-year exposure by $1.68x10^{-5}$. The radiological limit for an individual worker is 5,000 mrem/year (10 CFR Part 835). The maximum annual dose of 2,000 mrem/yr for an individual worker is set as an administrative guideline limit at SNL/NM.

Dosimetry Badges

All employees, contractors, and visitors entering or working in radiation areas are issued radiation monitoring devices known as dosimetry badges. The Sandia Dosimetry System (SANDOS) and the DOE's Radiation Exposure Monitoring System (REMS) databases record worker radiation dose information as the total effective dose equivalent (TEDE), which is a sum of external and internal radiation doses. The reporting limit for dosimetry badges used is 10 mrem above background, and therefore only exposures greater than or equal to 10 mrem are used in deriving the annual average collective TEDE for the radiation-badged worker population (workers receiving 10 mrem or more above background).

Exposure to Radiation

All people are constantly exposed to some form of radiation. This radiation can be from different sources: cosmic from space, medical from X-rays, internal from food, and external from rocks and soil (such as radon in homes). The "Roentgen equivalent, man" (rem) unit is a measurement of the dose from radiation and its physical effects and is used to predict the biological effects of radiation on the human body. Therefore, one rem of one type of radiation is presumed to have the same biological effects as one rem of any other type of radiation. This relationship allows comparison of the biological effects of radiological materials that emit different types of radiation. A commonly used dose unit of measure is millirem (mrem), which is equal to 0.001 rem. A person-rem is a collective radiation dose unit for expressing the dose when summed across all persons in a specified population group.

Nonradiological

Occupational Injuries/Illnesses

OSHA has identified the most important risks to the health of workers as common industrial accidents that normally involve falls, slips, trips, contact with objects,

Table 4.10–1. Radiation-Badged Worker Doses (TEDE) at SNL/NM (1992-1996)

RADIATION-BADGED WORKER[a]	YEAR	RADIATION DOSES	FEDERAL STANDARD/DOE GUIDELINE
Annual Average Dose[b] (millirem/year)	1992	35	ALARA
	1993	40	ALARA
	1994	52	ALARA
	1995	34	ALARA
	1996	47	ALARA
AVERAGE	**--**	**42**	**ALARA**
Annual Maximum Dose (millirem/year)	1992	920	5,000
	1993	520	5,000
	1994	830	5,000
	1995	500	5,000
	1996	845	5,000
AVERAGE	**--**	**723**	**5,000**
Annual Collective Dose (person-rem)	1992	16	ALARA
	1993	12	ALARA
	1994	10	ALARA
	1995	10	ALARA
	1996	12	ALARA
AVERAGE	**--**	**12**	**ALARA**

Source: SNL/NM 1997k
ALARA: as low as reasonably achievable
mrem: millirem
TEDE: total effective dose equivalent

[a] Radiation-badged workers are those having badges measuring greater than 10 mrem.
[b] Annual average dose equals the collective TEDE divided by the number of badges with a measured dose greater than 10 mrem above background, which is the detection limit of the dosimetry used.

and so on, and that result in sprains, cuts, abrasions, fractures, and other injuries. Monitoring and using personal protective equipment minimize or prevent overexposures to hazardous chemicals.

SNL/NM must comply with Federal requirements to track and report occupational illnesses and injuries as required by 29 CFR Part 1904, DOE O 231.1, DOE O 232.1, and the associated *OSHA Record Keeping Guidelines for Occupational Injuries and Illness, 1986* (29 CFR Part 1904). DOE contractors must report to DOE/Headquarters (HQ) the same type of information on occupational injuries and illnesses that private industry provides to the Bureau of Labor Statistics (BLS). SNL/NM and its contractors annually report all illnesses and injuries as required by OSHA. Table 4.10–2 and Figure 4.10–3 compare the 1992 through 1996 nonfatal injury/illness case rates per 100 workers (or 200,000 hours equivalent) for SNL/NM, the DOE, private industry in New Mexico, and private industry nationally. SNL/NM injury/illness rates are much lower than those of private industry (national or local) and are similar to the DOE as a whole.

The numbers of lost workdays resulting from nonfatal injuries and illnesses are also recorded annually. Table 4.10–3 and Figure 4.10–4 compare the lost workday case rates (number of lost workdays per 100 workers or 200,000 hours equivalent) for SNL/NM, the DOE and contractors, private industry in New Mexico, and private industry nationally. Both the DOE and SNL/NM show lower lost workdays than those of private industry (national and local).

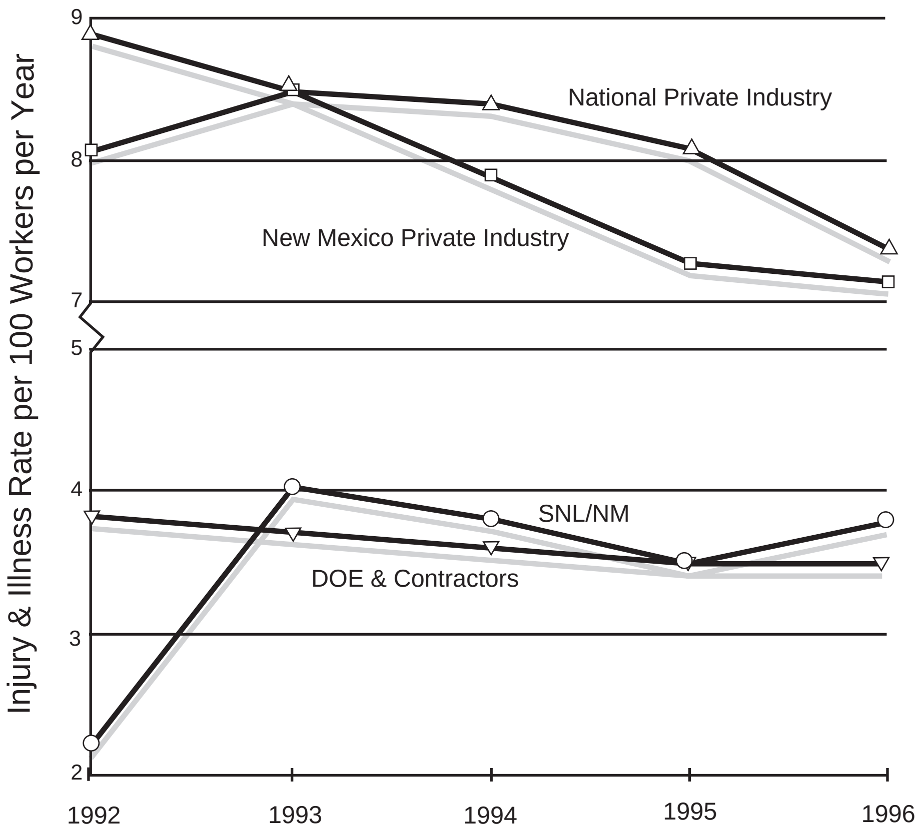
Occupational Fatalities

As shown in Table 4.10–4, approximately 6,000 occupational fatalities occur each year nationwide (SNL/NM 1997b). Private industry accounts for approximately 5,500 of that total. Based on 5 years of data listed in Table 4.10–4, New Mexico has an average of 57 occupational fatalities per year. Ninety percent of occupational fatalities occur in private industry, while government, including Federal, state, and local, account for 10 percent (DOL 1997j). SNL/NM has never experienced a fatal occupational injury (SNL/NM 1997b).

Table 4.10–2. Comparison of Nonfatal Occupational Injury/Illness Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	2.3	4.1	3.8	3.5	3.8
DOE & Contractors	3.8	3.7	3.6	3.6	3.5
New Mexico Private Industry	8.1	8.5	7.9	7.3	7.3
National Private Industry	8.9	8.5	8.4	8.1	7.4

Sources: DOE 1997b, n.d.(h); DOL 1996, 1997b-f, j, i, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l
[a] Rates are per 100 workers per year.



Sources: DOE 1997b, n.d. (h); DOL 1996, 1997b-f, i, j, n, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

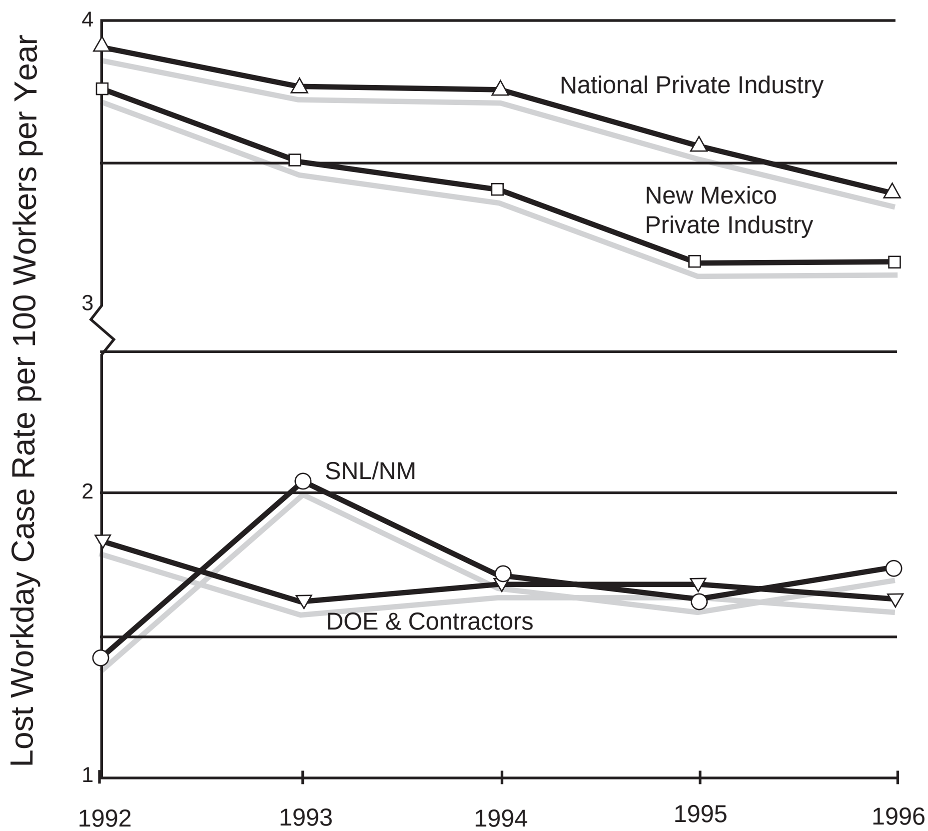
Figure 4.10–3. Comparison of Nonfatal Occupational Injury/Illness Rates (1992 through 1996).

SNL/NM's nonfatal occupational injury/illness rates compared favorably with local and national private industry rates.

Table 4.10–3. Comparison of Lost Workday Case Rates[a] (1992 through 1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	1.44	2.05	1.77	1.63	1.73
DOE & Contractors	1.8	1.6	1.7	1.7	1.6
New Mexico Private Industry	3.8	3.5	3.4	3.2	3.2
National Private Industry	3.9	3.8	3.8	3.6	3.4

Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l;
[a] Rates are per 100 workers per year.



Sources: DOE 1997b; DOL 1996, 1997b-f, i, j, 1998, n.d. (a) through (d); SNL/NM 1997b, 1998l

Figure 4.10–4. Comparison of Lost Workday Case Rates (1992 through 1996)

SNL/NM's lost workday case rates compared favorably with local and national private industry rates.

Table 4.10–4. Comparison of Total Fatal Occupational Injuries (1992-1996)

WORKFORCE SEGMENT	YEAR				
	1992	1993	1994	1995	1996
SNL/NM	0	0	0	0	0
New Mexico Private Industry	35[a]	55	54	58	60
National Private Industry	5,497	5,590	5,923	5,495	5,521
National Total (Government & Private Industry)	6,217	6,331	6,632	6,275	6,112

Sources: DOL 1992, 1993, 1994, 1995, 1997a, g, h, k-m; SNL/NM 1997b
[a] Reflects startup of collection program; number is considered low/conservative.

Occurrences

DOE O 231.1, *Environment, Safety and Health Reporting* (see Chapter 7), and its predecessors specify criteria for reporting specific conditions, incidences, or situations related to the safety and security of operations of DOE and its contractors in formal occurrence reports. Occurrence reporting increases sensitivity to potentially unsafe conditions, requires analyses to determine the causes of events, provides a vehicle for formal corrective actions, and fosters lessons-learned programs. The *ORPS* database tracks occurrences (DOE 1998h).

Table 4.10–5 lists, by reporting category, the SNL/NM occurrence reports between 1993 and 1996. The number of reportable occurrences in categories “personnel safety” and “personnel radiation protection” have remained relatively constant at SNL/NM (SNL/NM 1997b). The personnel safety category, which includes any reportable injury, illness, or overexposure to hazardous chemicals or radiation, accounts for less than 10 percent of reportable occurrences. Not all reported occurrences in Table 4.10–5 result in adverse effects on human health; they also report on other categories, such as security violations and observations that are potentially hazardous conditions.

Industrial Hygiene Reports

The industrial hygiene (IH) program monitors airborne chemicals and hazards in the workplace. A wide variety of workplace chemicals are monitored, such as heavy metals, VOCs, solvents, acids, as well as other potentially harmful health hazards, including noise and radio frequency.

The IH program investigates a wide variety of conditions and situations potentially involving health impacts to workers. An Industrial Hygiene Investigation Report (IHIR) is completed when formal investigations are conducted. IHIRs are performed or initiated through various avenues such as a worker complaint, scheduled monitoring, use assessments, worker risk assessments, change of building use (for example, changing laboratory to office space), and for other health and safety-related reasons.

Table 4.10–6 identifies the total number of IHIRs performed by IH program staff from 1992 through 1996. Less than 25 percent of these investigations involved air monitoring for worker exposures to hazardous materials, including chemicals in the workplace. Very few of these investigations ever revealed an environment where an overexposure to a chemical (above a health control limit) might occur. Reportable/recordable chemical exposures to an individual are reported in the *ORPS* database (DOE 1998h). The SNL/NM *Worksite Accident Reduction Expert (WARE)* database captures personal chemical exposure incidents (both OSHA/DOE recordable/reportable) (SNL/NM 1998d, 1998k). These incidents are investigated by either safety or industrial hygiene representatives, depending upon the type of accident, illness, or injury. Investigation report results are entered by safety representatives into the SNL/NM *WARE* database, which ultimately feeds recordable incidents into the DOE’s *Computerized Accident/Incident Reporting System (CAIRS)* database, or directly by industrial hygiene personnel into the *CAIRS* database through completed IHIR reports. These databases identify personal chemical exposures exceeding a health control limit and are investigated or reported in the *ORPS* database.

A search was performed in the DOE’s *ORPS* and *CAIRS* databases and SNL/NM’s *WARE* database for personal chemical overexposures exceeding a health control limit. Data showing SNL/NM personal chemical exposures for 1992 through 1996 are listed in the bottom row of Table 4.10–6. Within SNL/NM facilities, one or two reportable chemical exposures occurred each year during the past 5 years. None of these were monitored overexposures. SNL/NM has an extensive safety and health program, compliance policies, and personal protective procedures in place to reduce or minimize the potential for work-related chemical exposures to hazardous or toxic chemicals.

Table 4.10–5. SNL/NM Safety and Security Occurrences by Reporting Category (1993-1996)[a]

CATEGORY	YEAR			
	1993	1994	1995	1996
Facility Condition	48	25	27	33
Environmental	11	16	6	2
Personnel Safety	1	5	2	4
Personnel Radiological Protection	2	2	4	3
Safeguards & Security	7	1	5	3
Transportation	1	2	2	1
Value Basis Reporting	2	4	4	3
Facility Status	0	0	0	0
Nuclear Explosive Safety	0	0	0	0
Cross Category Items	5	4	4	12
GRAND TOTAL	**77**	**59**	**54**	**61**

Source: SNL/NM 1997b
[a] Some occurrences received more than one classification, so the total differs slightly from the total number of occurrences.

Table 4.10–6. SNL/NM Industrial Hygiene Investigation Reports Summary (1992-1996)

IHIRs	YEAR				
	1992	1993	1994	1995	1996
Total Number of IHIRs	436	702	933	799	411
Number With Hazardous Material Air Monitoring Data	151	210	207	113	65
Number With Data Showing Personal Chemical Exposures	1	1	2	0	2

Sources: SNL/NM 1997e, 1998d, 1998k
IHIR: Industrial Hygiene Investigation Report

4.11 TRANSPORTATION

4.11.1 Definition of Resource

This section describes current regional and local transportation activities, including descriptions of any highway, rail, air, or marine transportation infrastructure that the DOE uses to support hazardous material and waste movements at SNL/NM. Transportation activities at SNL/NM involve the receipt, shipment, and transfer of hazardous and nonhazardous materials and waste. Receipt refers to material received from an offsite location; shipment refers to material sent to an offsite location; and transfer refers to material moved from one onsite location to another.

4.11.2 Region of Influence

The transportation ROI consists of three areas: within KAFB, the major transportation corridors in Albuquerque, and the routes to and from DOE facilities and waste disposal sites.

4.11.3 Affected Environment

Moving or transporting hazardous material and waste under any conditions can pose inherent risks and impacts to workers and the public. However, SNL/NM has standard operating procedures in place to minimize these risks, and to ensure worker and public safety. Normal transportation activities affect air quality, noise and vibration, and traffic congestion. Some degree of external radiation exposure to workers and the public, which is known as incident-free exposure, also occurs during routine operations.

4.11.3.1 Responsible Organizations and Materials Tracking

SNL/NM organizations share responsibility for ensuring the safe receipt, shipment, and transfer of hazardous material and waste. These organizations perform the administrative and logistical operations involved in inspecting, packaging, handling, loading, transferring, shipping, and receiving these materials.

Accountable radioactive material receipts, shipments, and onsite transfers are tracked through the *Local Area Network Nuclear Material Accountability System (LANMAS)*, a database that tracks the location of nuclear materials inventory. Explosive material shipments are tracked through the Explosive Inventory System, which records all receipts, onsite transfers, and shipments of explosive materials by tracking the movement of each individual unit. It is common for several trackable units to be moved simultaneously on the same conveyance.

Chemical purchases are tracked through the Chemical Inventory System (CIS) maintained by SNL/NM. The majority of chemical purchases, received in small quantity containers, are made through the just-in-time (JIT) procurement procedures, which are designed to limit any excess chemical inventory in storage onsite. Other purchases, delivered in bulk loads, include compressed gasses such as hydrogen and liquid nitrogen, large quantity acids and bases, and bulk fuels. JIT chemical vendors are required to issue a 10-digit barcode to each chemical container and to compile the following delivery information: vendor catalog number, quantity, unit of measure, delivery location (building, room, and quad), organization number, delivery date and time, person delivered to, price, and the material requisition number. The vendor is also responsible for providing the following chemical-specific data for inclusion in the CIS files: chemical name, physical state, manufacturer/supplier name, standard industry barcode number, Chemical Abstract Service (CAS) numbers of ingredients, *Superfund Amendments and Reauthorization Act* (SARA) storage code, SARA temperature code, SARA pressure code, and National Fire Protection Association (NFPA) codes. The vendors are required to transfer the accumulated data and catalog updates to the SNL/NM CIS every Monday, Wednesday, and Friday, or as otherwise agreed upon by the vendor and the CIS department. Each vendor is responsible for the accuracy of the data they submit to the CIS. In addition, vendors also provide Material Safety Data Sheets (MSDSs) for all chemicals not having an MSDS on record.

4.11.3.2 Types and Quantities of Material and Waste Transported

The affected environment considered under this analysis includes all transportation activities related to normal operations at SNL/NM. Normal operations encompass all operations required in order to maintain production at SNL/NM facilities. However, special operations, those operations outside the scope of normal facility production, sometimes occur and can have a substantial effect on the overall transportation activities at SNL/NM. Special operations and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception. These are also included in the site-wide analysis. One special program, the ER Project, is discussed separately because, within its limited duration, this project will be the single largest waste generator at SNL/NM, based on current projections.

Table 4.11–1 lists the number of hazardous material and waste shipments, receipts, and transfers made by SNL/NM during 1996. U.S. Department of Transportation (DOT)

Table 4.11–1. Annual Receipts, Shipments, and Transfers of Hazardous Material at SNL/NM

TYPE OF MOVEMENT		HAZARDOUS MATERIAL/WASTE	NUMBER OF MOVEMENTS[a]
Receipt	**Materials**	Radioactive material[b]	109 (1997)
		Chemical material	2,750 (1997)
		Explosives	123 (1997)
		Fuels:	
		Diesel/unleaded	0
		Jet	0
		Propane	136
	Waste	TRU	0
		MTRU	0
		LLW	0
		LLMW	1
		Hazardous waste[c]	12 (1997)
		Solid waste	0
Shipment	**Materials**	Radioactive material[b]	196 (1997)
		Chemical material	164
		Explosives	180 (1997)
	Waste[d]	TRU	0
		MTRU	0
		LLW	4
		LLMW	1
		Hazardous waste[c]	64 (1997)
		Recycled	8 (1997)
		Solid waste	51 (1997)
	ER Waste[f]	TRU	0
		MTRU	0
		LLW	22
		LLMW	0
		Hazardous waste[c]	27 (1997)
Transfer	**Materials**	Radioactive material[b]	10 (1997)
		Chemicals[h]	0
		Explosives	1,453 (1997)
		Fuels:	
		Diesel/unleaded	72
		Jet	1
		Propane	0
	Waste	TRU[g]	0 (1997)
		MTRU[g]	4 (1997)
		LLW[g]	761 (1997)
		LLMW[g]	35 (1997)
		Hazardous waste[c]	Daily
		Solid waste	Daily

Source: SNL/NM 1997a
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
TSCA: *Toxic Substance Control Act*
[a] 1996 figures unless otherwise noted
[b] Data are restricted to accountable nuclear material
[c] Hazardous waste includes RCRA, TSCA, and medical waste.
[d] Waste shipments due to normal operations
[e] The Hazardous and Solid Waste Department records the quantity of waste shipped offsite. This assumes that the quantity of waste collected on the site in any year is approximately equal to the quantity shipped offsite for disposal.
[f] Waste shipments due to the ER Project, a limited duration special project
[g] Data are in terms of the estimated maximum collection trips per year by the Radioactive and Mixed Waste Department. Actual onsite conveyances of radioactive and mixed wastes are not included in the table.
[h] Chemical transfers are included within the chemical waste shipments.

definitions and standards (49 CFR Part 173) establish the means to determine if a material constitutes a hazard for offsite transportation. SNL/NM standards, which were developed in accordance with DOE, DOT, and USAF policies, determine if a material constitutes a hazard for onsite transportation. A *hazardous material*, as defined in 49 CFR Part 173, is one that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, can, without proper management, significantly contribute or pose a potential hazard to human health or the environment. The types of SNL/NM hazardous materials regulated by the DOT include radioactive materials, chemicals, explosive materials, and fuels. There are also three types of waste transported by SNL/NM: radioactive waste; hazardous waste (which includes RCRA chemical and explosives waste, medical waste, and TSCA waste, primarily asbestos and polychlorinated biphenyls [PCBs]); and nonhazardous solid waste.

In 1997, SNL/NM received more than 25,000 chemical containers in approximately 2,750 shipments. The majority of these receipts were small quantity purchases made through the JIT vendors. The remainder of the receipts were large quantity purchases received as bulk loads, including compressed hydrogen tube trailers, and acids received from tanker trucks. Typically, JIT chemicals are provided through local vendors and are usually shipped from locations within 40 km of SNL/NM.

In 1997, the JIT materials received from Fisher Scientific (representing 25 percent of all JIT chemicals received from vendors) were primarily flammable, approximately 46 percent (DOT Hazard Class [HC] 3); corrosive, approximately 35 percent (HC 8); and toxic substances, approximately 2 percent (HC 6.1) (FWENC 1998a). Flammables include materials such as acetone, isopropyl alcohol, methanol, propyl alcohol, and toluene. Corrosives include materials such as nitric acid, acetic acid, sulfuric acid, hydrogen chloride, and sodium hydroxide. Toxic chemicals include materials such as methylene chloride, trichloroethene, and chloroform.

Chemicals are the most frequently received hazardous materials at SNL/NM. The second most frequently received hazardous material is radioactive material. Radioactive and explosive materials shipments are often delivered through government carriers.

SNL/NM ships radioactive material in both excepted and DOT-specific packaging. The most common type of shipments is excepted packaging shipments. Packaging includes containers and all accompanying components or materials required to adequately contain the material.

Radioactive material that is shipped in excepted packaging has a radioactive level below the limit established in specific regulations contained within 49 CFR Part 173. Generally, in order to be shipped as excepted packaging, the radiation exposure level at any point along the surface of the package cannot exceed 0.5 mrem per hour. The package type used must meet the standards set by the carrier and a statement must be included with the package that cites the specific regulation within 49 CFR Part 173 allowing the material to be shipped without shipping papers. Typical materials that fall under the excepted material criteria are low-level radioactive source material, instruments, and empty packaging.

Material with radioactive levels in excess of the excepted packaging regulations must be shipped in either a Type A or Type B container. Type A containers are designed to undergo the routine stresses of transport. For a container to be considered Type A, it must be constructed and identified as following specific guidelines found within 49 CFR Part 173. Radioactive material requiring Type A containers consists of two categories, A1 and A2. A1 material is "special form" radioactive material, and A2 material is radioactive material in forms other than special form and low-specific-activity (LSA) radioactive material. Maximum activities of isotopes for A1/A2 are found in both 10 CFR Part 71 and 49 CFR Part 173. Radioactive material exceeding the activities posted in the A1/A2 table must be shipped in a Type B container. Type B containers are designed and tested to undergo stresses that exceed those usually associated with routine shipping, such as wrecks, fires, and so on. LSA radioactive material is shipped in industrial packing containers. Specifications for these containers are also found in 49 CFR Part 173. Chapter 7 provides detailed information regarding the specific regulations cited above.

SNL/NM also purchases propane to provide space heating to TAs-III and -V and other remote areas. Propane purchases should diminish significantly in the near future as remote facilities convert to natural gas heating. Offsite sources deliver other fuels, such as gasoline, diesel, and jet fuels, directly to KAFB. Then SNL/NM purchases these fuels from KAFB as needed; thus, most fuel shipments are considered transfers rather than receipts.

4.11.3.3 Destinations and Origins of Shipments, Receipts, and Transfers

SNL/NM receives radioactive material and explosives from a number of locations across the U.S. and, since 1994, has shipped radioactive material to 96 locations. The common and recently used destinations are listed in Table 4.11–2. At

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
RECEIPTS			
Materials	Radioactive	Los Alamos National Laboratory, Los Alamos, NM	30
		Pantex Plant, Amarillo, TX	31
		Martin Marrietta, Largo, FL	17
	Chemical	Various local vendors, Albuquerque, NM (1997)	2,750
	Explosive[b]	Pantex Plant, Amarillo, TX (1997)	22
		SNL/CA, Livermore, CA (1997)	18
		Strategic Weapons Facility – Pacific, Silverdale, WA	9
		Tonopah Test Range, Tonopah, NV (1997)	19
		New explosive material (1997)	423
Waste	Hazardous	SNL/NM, Albuquerque offsite laboratories	12
	LLMW	SNL/CA, Livermore, CA	2
	TRU	Lovelace, Albuquerque, NM	0
SHIPMENTS			
Materials	Radioactive	Harris Semiconductor, Mountaintop, PA	65
		El Segundo, CA	33
		Pantex Plant, Amarillo, TX	12
	Chemical	Burnet, TX	13
		Carlsbad, CA	16
		Livermore, CA	9
	Explosive (1997)	Los Alamos National Laboratory, Los Alamos, NM	11
		Strategic Weapons Facility - Atlantic, Kings Bay, GA	26
		Vandenberg AFB, CA	25
		Strategic Weapons Facility – Pacific, Silverdale, WA	24
		Tonopah Test Range, Tonopah, NV	20
Waste	LLW	Envirocare, Clive, UT	0 (22 ER)
		Nevada Test Site, Mercury, NV	4
	LLMW	Permafix, Gainesville, FL	1
		DSSI, Oak Ridge, TN (from Permafix)	0
		Envirocare, Clive, UT	14
	TRU/MTRU	Los Alamos National Laboratory, Los Alamos, NM (1997)	0

Table 4.11–2. Most Common Origins/Destinations of SNL/NM Materials and Waste Receipts and Shipments (concluded)

TYPE OF MOVEMENT	TYPE OF MATERIAL/WASTE	MOST COMMON ORIGIN/DESTINATION	MOVEMENTS[a]
Waste (continued)	Hazardous (1997)	Deer Park, TX	5
		ENSCO, El Dorado, AK (1997)	11
		Keers, Mountainair, NM	9
		Kirtland AFB, Albuquerque, NM (1997)	7
		Laidlaw – Gray Back, UT (1997)	1
		Laidlaw – Grassy Mountain, UT (1997)	8 (27 ER)
		Laidlaw – Lone Mountain, Waynoka, OK (1997)	1
		Laidlaw – Aptus, Aragonite, UT	12
		Laidlaw – BDT, Clarence, NY (1997)	4
		NSSI – Sources & Services, Inc, Houston, TX (1997)	1
		Salesco Systems, Inc, Phoenix, AZ (1997)	4
		Transformer Disposal Specialists, Tonkowa, OK (1997)	2
	Solid Waste	Rio Rancho Sanitary Landfill, Rio Rancho, NM (1997)	51
	Recyclable Hazardous (1997)	Kinsbursky Brothers, Anaheim, CA	2
		Safety-Kleen Corp, Albuquerque, NM	2
		Tab Manufacturing, Albuquerque, NM	4

Sources: FWENC 1998a; Rinchem 1998a; SNL/NM 1997a, 1998z, 1998aa
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
SNL/CA: Sandia National Laboratories/California
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
[a] Figures given for 1996 unless otherwise noted
[b] Many explosives received were new explosives. In 1997, 423 of 638 trackable units received were new with no tracking unit number. Because unit numbers were identified, actual numbers of these receipts is unknown.

present, SNL/NM ships hazardous waste offsite to several facilities for treatment and disposal. Most of these sites are located in the southwestern U.S. (Table 4.11–2).

4.11.3.4 Historic Records of Hazardous Material Transportation Incidents

Since 1994, SNL/NM has had six transportation-related incidents involving the onsite transfer of hazardous material. One incident occurred in 1997, two in 1996, and three in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment. No member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents. Only one incident, on April 12, 1994, involved injuries to occupants of the vehicle involved.

Since 1994, SNL/NM has had seven transportation-related incidents involving the offsite shipment or receipt of hazardous material. Two incidents occurred in 1998, two in 1996, two in 1995, and one in 1994 (Table 4.11–3). None resulted in the release of a hazardous cargo to the environment and no member of the workforce or the public was exposed to or harmed by hazardous material related to the incidents.

4.11.3.5 Emergency Response and Training

The *Emergency Preparedness Plan* describes the process SNL/NM uses to prepare for and respond to emergencies (SNL/NM 1997a). The plan is reviewed annually and revised as necessary. Emergency planning is required under the *Emergency Planning and Community Right-to-Know Act of 1996* (42 U.S.C. §11001).

Table 4.11–3. SNL/NM Transportation Incidents, 1994 to 1998

DATE	INCIDENT DESCRIPTION	INJURIES	DEATHS	HAZARDOUS MATERIAL	MATERIAL RELEASED
ONSITE INCIDENTS					
4/12/94	Truck rollover with minor injuries	Yes	No	Two compressed gas cylinders	No
6/10/94	Material being moved sustained a leak of nonPCB-bearing transformer oil.	No	No	Oil	No
9-30-94	Radioactive material being transported in improperly placarded vehicle	No	No	Radioactive material	No
2/13/96	Radioactive contamination found in container in a nonradioactive control area.	No	No	Radioactive contamination	No
8/12/96	Survey found radioactive material in items sent to property reapplication.	No	No	Radioactive material	No
8/1/97	Radioactive Class II item being transported was improperly shipped as a radioactive limited quantity material.	No	No	Radioactive material	No
OFFSITE INCIDENTS					
6/20/94	Sample material sent to contract laboratory was identified as radioactive.	No	No	Radioactive material	No
1/11/95	SNL/NM assessed two violations for hazardous materials that were not properly classified, marked, or labeled.	No	No	Hazardous material	No
3/21/95	Explosives shipped in shipping pipe labeled as empty	No	No	Explosives	No
1/23/96	Follow-up survey found a container with internal radioactive contamination.	No	No	Radioactive material	No
9/11/96	Hazardous material package incorrectly packaged and labeled	No	No	Hazardous material	No
2/19/98	Shipment from vendor of explosive components received with cap not attached to safety containment cylinder.	No	No	Explosives	No
3/18/98	Radioactive material contamination levels found to exceed DOT limits concerning receipt and subsequent shipment offsite. Follow-up surveys at destination indicated material to be below DOT limits.	No	No	Radioactive material	No

Source: SNL/NM 1998f
PCB: polychlorinated biphenyl
DOT: U.S. Department of Transportation

4.11.3.6 SNL/NM Site-Related Traffic

Road Network

Interstate 40, which runs east-west, and Interstate 25, which runs north-south, are the two major routes through Albuquerque. (Figure 4.2–1) Figure 4.11–1 shows the road network for the city of Albuquerque. Figure 4.11–2 shows the road network for SNL/NM and KAFB and the onsite routes specified for transporting hazardous material.

In 1995, approximately 7,868 trucks were estimated to have entered Albuquerque by way of interstates on any given work day; however, only 1,514 were placarded, and only 383 of these were indicated to be carrying hazardous materials. SNL/NM made an estimated 15 offsite truck shipments per day in 1996.

Traffic enters SNL/NM through three principal KAFB gates; Wyoming, Gibson, and Eubank. These gates handle 26 percent, 30 percent, and 20 percent of the total traffic entering KAFB, respectively. An additional entrance to KAFB, the Truman gate, serves KAFB's western area, and exclusively handles KAFB-related traffic. The principal mode of transportation for moving hazardous material shipments to or from SNL/NM is by truck. Most commercial truck traffic to SNL/NM uses the Eubank gate because it provides easy access to SNL/NM shipping and receiving in Building 957 (TA-II).

Other SNL/NM Modes of Transportation

SNL/NM uses the Albuquerque International Sunport for passenger and airfreight services. Commercial airfreight services, such as Emery Air Freight or Federal Express, are available at the Sunport. Ross Aviation, Inc., also located at the Sunport, is available to support DOE programs and operations. Access to Ross Aviation is at the east end of KAFB.

Occasionally, SNL/NM may ship materials to or from Kauai, Hawaii, either by way of air or marine transport, based on regulatory requirements and restrictions. Such shipments occur as needed and could be hazardous in nature. However, since 1994, no identified shipments have used marine transport.

Since the Burlington Northern & Santa Fe Railroad, located in Albuquerque, discontinued its spur to KAFB in 1994, SNL/NM has not had an active rail spur. Any current or future rail shipments would have to travel by truck to the Santa Fe railway yard in downtown Albuquerque.

Employee-Related Traffic Volume

SNL/NM staff coming to and leaving KAFB and traffic from maintenance and contractor vehicles are significant contributors to KAFB traffic. A recent estimate of the employee-related traffic volume describes the traffic from SNL/NM commuters and SNL/NM and DOE-owned vehicles (SNL 1996c). The Sandia Vehicle Decal Office issued 22,940 decals in a 3-year period for SNL/NM employees, SNL/NM contractors, and DOE personnel. During the same period, 40,959 decals were issued for KAFB (exclusive of those associated with SNL/NM). Thus, SNL/NM accounted for 36 percent of the 63,899 decals issued.

An earlier traffic study by the Middle Rio Grande Council of Governments also determined that SNL/NM accounted for 36 percent (13,582 vehicles) of daily KAFB commuters (SNL 1996c).

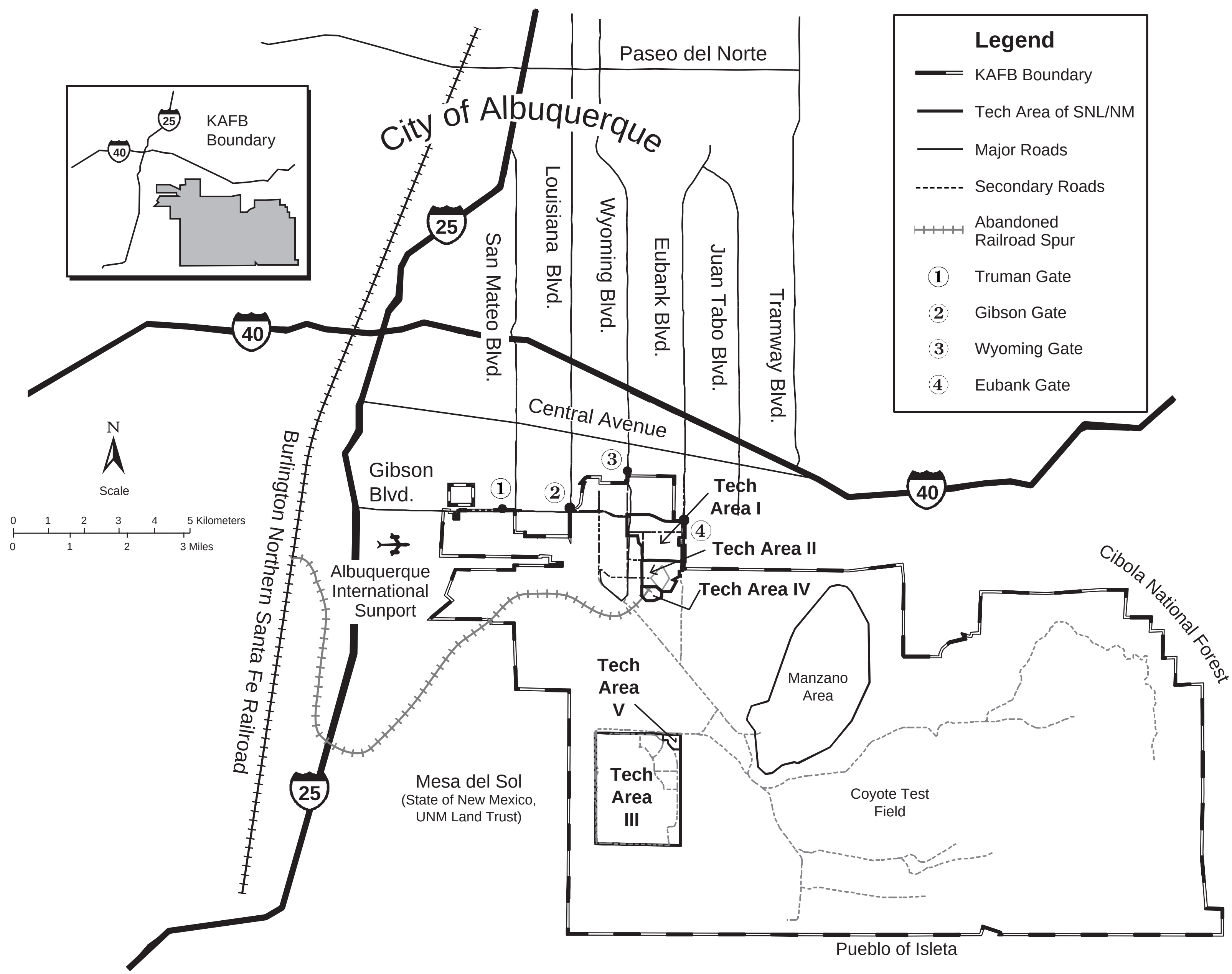
4.11.3.7 Traffic Accident Injuries and Fatalities

Table 4.11–4 lists SNL/NM traffic accidents from 1994 through 1997. Some of the accidents caused minor injuries, but none caused fatalities.

Table 4.11–4. Traffic Accidents Involving SNL/NM Vehicles

DATE	ACCIDENT	INJURIES	DEATHS
2/23/94	Pedestrian accident with minor injuries	Yes (minor)	No
4/12/94	Truck rollover with minor injuries	Yes	No
11/17/94	SNL/NM employee suffered broken arm during palletizing activity	Yes	No
12/17/94	Truck caught fire	Yes	No
2/2/94	Security vehicle backed into 2-ft post; gas tank punctured	No	No
7/17/96	Government van involved in collision in downtown Albuquerque	Yes (minor)	No
1/13/97	Pedestrian struck by motorized cart at SNL/NM	Yes	No

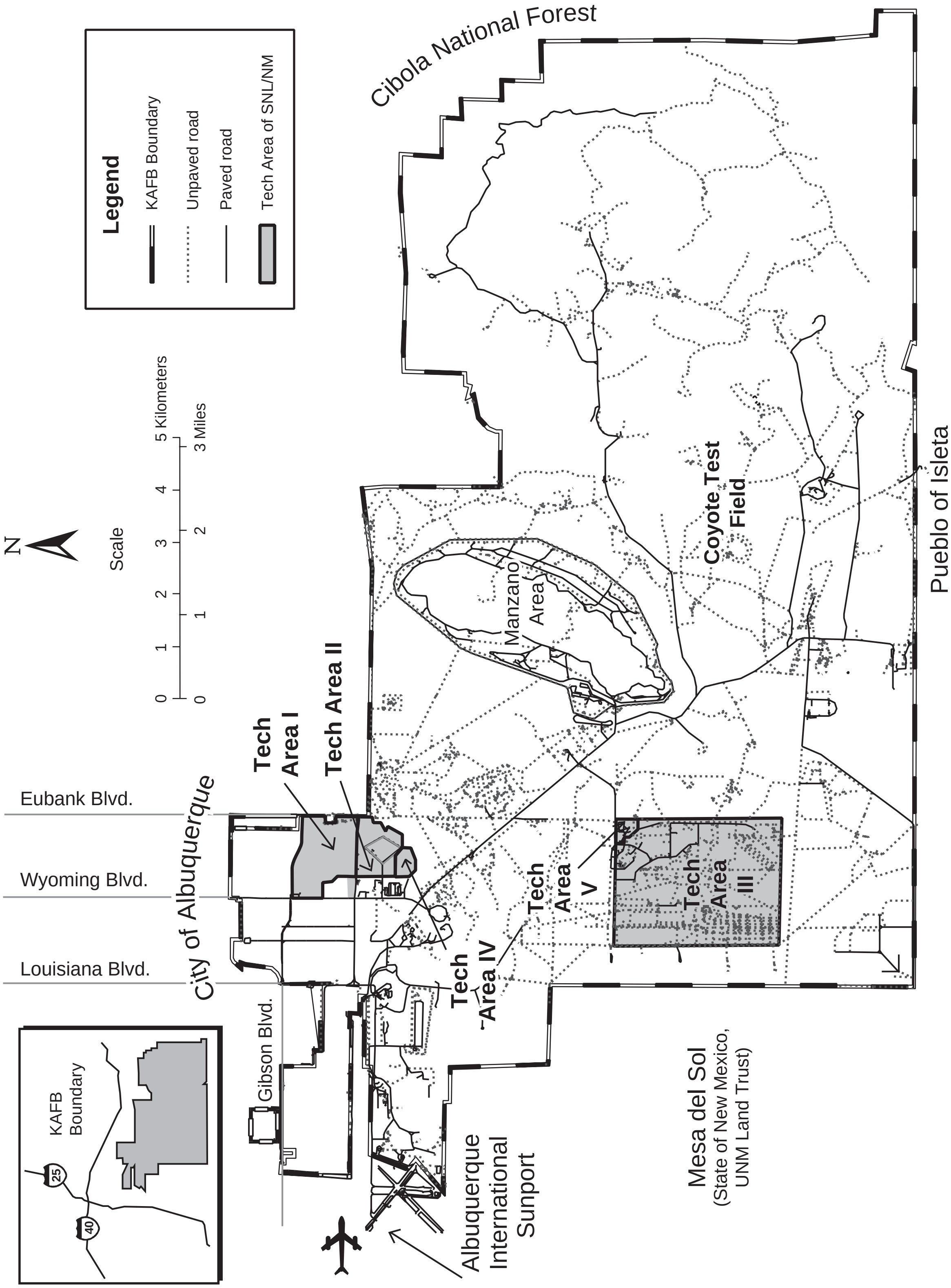
Source: SNL/NM 1997a



Source: SNL/NM 1997i

Figure 4.11–1. Major Albuquerque Transportation Routes

Interstates 40 and 25 and a network of streets maintained by the city of Albuquerque serve KAFB.



Source: SNL/NM 1997j

Figure 4.11–2. KAFB Transportation Routes

A large network of roads is used to transport material and wastes from site to site on KAFB.

4.12 WASTE GENERATION

4.12.1 Definition of Resource

Waste management activities consist of managing, storing, and preparing for offsite disposal of all wastes in accordance with applicable Federal and state regulations, permits obtained under these regulations, and DOE orders. The waste categories generated onsite under normal operations include radioactive waste (including LLW, LLMW, transuranic [TRU] waste and mixed transuranic [MTRU] waste); hazardous waste, which includes RCRA hazardous (chemical and explosives) waste and biohazardous (medical) waste; TSCA waste (primarily asbestos and PCBs); and nonhazardous solid waste and process wastewater.

4.12.2 Region of Influence

The ROI for waste generation involves SNL/NM and its facilities, including the HWMF, the TTF, the Solid Waste Transfer Facility (SWTF), the RMWMF, the High Bay Waste Storage Facility (HBWSF), the Interim Storage Site (ISS), and offsite SNL operations that generate and ship waste to SNL/NM (Table 4.11–2). The process design capacities for radioactive waste storage units covered under existing permits are shown in Table 4.12–1. The ROI does not include offsite waste disposal facilities because they involve the private sector or other Federal facilities. Waste management facility locations are shown in Figure 4.4–2.

The transportation of waste is discussed in Section 4.11, and details of the analysis are presented in Appendix G .

4.12.3 Affected Environment

The generation of the many different waste streams at SNL/NM creates a continuous need for proper packaging, labeling, manifesting, transporting, storing, and disposing solutions.

4.12.3.1 Normal Operations

The affected environment considered under this analysis is limited to those facilities that generate waste under normal operations at SNL/NM. Normal operations encompass all current operations that are required to maintain production at SNL/NM facilities. Other waste considered includes small amounts generated from SNL or DOE-funded operations at other DOE or Federal facilities that may also be managed at SNL/NM. For example, historically, TRU waste generated by the

Radioactive Waste Categories

***Low-Level Waste* (LLW)**—Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or by-product tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the *Atomic Energy Act* [42 U.S.C. §2011]). Test specimens of fissionable material, irradiated for research and development only and not for the production of power or plutonium, may be classified as LLW, provided that the concentration of transuranic is less than 100 nanocuries per gram.

***Low-Level Mixed Waste* (LLMW)**—Waste that contains both hazardous waste regulated under the *Resource Conservation and Recovery Act* (42 U.S.C. §6901) and low-level waste.

Transuranic Waste (TRU)—TRU waste is waste containing more than 100 nanocuries of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary of the U.S. Department of Energy has determined, with concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic Waste (MTRU)—TRU waste that also contains hazardous waste, as defined and regulated under the *Resource Conservation and Recovery Act* (42. U.S.C. §6901).

Other Waste Categories

Hazardous Waste—Any solid waste (definition includes semisolid, liquid, or gaseous material) having the characteristics of ignitability, corrosivity, toxicity or reactivity, defined by the *Resource Conservation and Recovery Act* (RCRA).

Nonhazardous Waste—Chemical waste not defined as a RCRA hazardous waste. The term nonhazardous waste does not necessarily imply the level of protection needed to properly manage the waste.

Table 4.12–1. Process Design Capacity for Radioactive Waste Storage Units at SNL/NM

UNIT	CONTAINER STORAGE (m^3)
RMWMF	8,000
HBWSF	1,800
Manzano Bunker 37034[a]	235
Manzano Bunker 37045[a]	176
Manzano Bunker 37055[a]	176
Manzano Bunker 37057[a]	176
Manzano Bunker 37063[a]	235
Manzano Bunker 37078[a]	279
Manzano Bunker 37118[a]	279
ISS	510
TOTAL	**11,866**

Source: DOE 1996c
HBWSF: High Bay Waste Storage Facility
ISS: Interim Storage Site
m^3: cubic meters
RMWMF: Radioactive and Mixed Waste Management Facility
[a] Bunkers are located within the Manzano Area (see Figure 4.4–2).

Lovelace Respiratory Research Institute has been managed at SNL/NM.

4.12.3.2 New Operations

Several new operations are currently in the planning stages at SNL/NM. However, they are considered outside of the scope of the current affected environment description for this analysis because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. SNL/NM has identified operations at four facilities that fall under this category: Tera-Electron Volt Energy Superconducting Linear Accelerator (TESLA), Radiographic Integrated Test Stand (RITS), Hot Cell Facility (HCF), and Annular Core Research Reactor (ACRR). The latter two are associated with the Molybdenum Isotopes Production Project (MIPP) (DOE 1996b). Due to the specific nature of waste material, it will be handled at the originating facilities until shipped offsite for disposal. Waste generated during the preparations for these operations has been omitted from assessments of existing operations in this SWEIS.

4.12.3.3 Special Projects

Special projects are limited-duration projects, such as corrective actions, that are considered separately from facility production. These projects can make a large contribution to the overall waste generation activities at SNL/NM. However, special projects and new programs routinely undergo program-specific assessments to consider any impacts that may result from their inception and are, therefore, not considered in-depth in the SWEIS.

One special project, the ER Project, within its limited duration, will actually be the single largest waste generator at SNL/NM, although it is not a component of normal operations. The Office of Environmental Management (EM) manages the ER Project, which is a phased program designed to identify, assess, and remediate DOE-owned or -operated facilities that have contamination from disposal sites, releases, or spills. SNL/NM has received a permit modification from EPA Region VI and the NMED for a Corrective Action Management Unit (CAMU) designed to be a treatment and disposal unit exclusively for ER Project-generated hazardous waste. The CAMU is near the former Chemical Waste Landfill (CWL), an ongoing ER Project remediation site near the southern boundary of TA-III. Authorization has been received from the EPA and NMED to treat metal-contaminated soil and organic compound-contaminated soil, respectively. Construction of the bulk waste staging area and temporary storage area components of the CAMU has been completed. Construction will be completed on the treatment area and disposal cell components of the CAMU as needed to accommodate contaminated soil from the CWL and other ER Projects. Excavation of the CWL was scheduled to begin in September 1998. The *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* analyzes potential environmental effects of the characterization and waste cleanup or corrective action at ER sites (DOE 1996c).

Other facility maintenance and infrastructure support operations would continue (as outlined in Section 2.3.5) with refurbishment, renovation, and removal of outdated facilities such as small office buildings, temporary structures, and trailers. Appendix D of the SNL Sites Comprehensive Plan identifies the specific structures under consideration over the next 10 years (SNL 1997). This program will potentially generate large volumes of TSCA waste, primarily asbestos, and building debris that will increase SNL/NM's disposal needs. One hundred thirty-eight buildings, accounting for 179,204 gross ft^2, are scheduled for removal within FY 1998 and FY 1999. Building debris estimates associated with this special project are included in the assessments of the waste generated from existing operations. Separate NEPA review may be required in the future depending on the scale and extent of the work involved.

4.12.3.4 Radioactive Waste

Radioactive waste generated at SNL/NM includes LLW, TRU waste, LLMW, and MTRU waste. Radioactive waste is characterized as either TRU or LLW, according to its radiological characteristics. Either type is considered mixed waste (MTRU or LLMW) if it also contains a RCRA hazardous waste component. LLW and LLMW are produced primarily in laboratory experiments and component tests. Other R&D activities that use radioactive materials may also generate LLW. TRU and MTRU wastes are produced in reactors and from the cleanup of reactor tests.

As part of the effort to minimize the total quantity of radioactive waste that is generated at SNL/NM, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMA). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to beams or other sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the location of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed with the Generator Interface and Pollution Prevention Department, Health Protection Department, and the Radiation Protection Operation Department.

SNL/NM has the capability to treat some mixed wastes onsite at the RMWMF and HBWSF. Treatment methods, quantity limits, and amounts treated in 1996 are shown in Table 4.12–2. Although treatment capacity appears to exceed demand, this is a permitted treatment quantity, based on the actual equipment, and often assumes conditions for operation not intended by the facility. Limits are often rate-oriented (for example, kg per hour) even though the actual operations are of short duration.

Historic Radioactive Waste Generation

Radioactive waste has historically been generated from the use of plutonium and other TRU isotopes, experiments involving nuclear reactor fuels, or R&D activities that used radioactive materials. In addition, small quantities are periodically received from remote test facilities and the Lovelace Respiratory Research Institute on KAFB. Table 4.12–3 summarizes radioactive waste quantities generated onsite from 1992 through 1995.

Current Radioactive Waste Generation

Table 4.12–4 presents information on the generation of radioactive waste during 1996. It lists totals by waste type and major generators.

Legacy Waste

Legacy waste is considered to be waste material currently in storage pending disposal. SNL/NM is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, legacy waste is either radioactive or classified. Radioactive legacy waste, currently in storage pending treatment or disposal, is discussed in Appendixes G and H. ER Project-generated waste is considered a type of legacy waste; however, within the SWEIS, ER Project waste is addressed separately. Projections for elimination of radioactive legacy waste are shown in Figures 4.12–1, 4.12–2, and 4.12–3. All radioactive waste in storage at the end of FY 1998 is considered to be legacy waste. Figure 4.12–1 shows that legacy LLW inventory will be reduced to zero by the end of FY 2005. Figure 4.12–2 shows that legacy LLMW inventory will be reduced to zero by the end of FY 2002. Figure 4.12–3 shows that the legacy TRU/MTRU inventory will be reduced to zero in FY 2004, with shipment of this waste to LANL for certification.

4.12.3.5 Hazardous Waste

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, biohazardous medical waste, and TSCA waste (primarily asbestos and PCBs). The hazardous waste generated at SNL/NM is predominantly chemical laboratory trash generated from experiments, testing, other research and development (R&D) activities, and infrastructure fabrication and maintenance.

Historic Hazardous Waste Generation

SNL/NM disposed of hazardous waste onsite from the start of operations until 1981. After 1981, waste was shipped offsite for disposal. Table 4.12–5 contains a summary of hazardous waste generated during normal operations from 1992 through 1995. Medical waste

Table 4.12–2. Mixed Waste Treatments, Quantity Limits, and Amounts Treated Onsite in 1996

TREATMENT [a]	PROCESS LIMIT		AMOUNT TREATED IN 1996
	RMWMF	HBWSF	
Container Storage	8,000,000 L	1,500,000 L	
Thermal Treatment	110 kg per hour	110 kg per hour	None
Neutralization	1,000 L per day	1,000 L per day	21 L
Chemical Treatment	537 kg per hour	537 kg per hour	<1 kg
Centrifugation	360 gal per hour	360 gal per hour	None
Encapsulation	0.3 L per hour	0.3 L per hour	None
Flocculation	360 gal per hour	360 gal per hour	None
Physical Treatment	6,500 L per day	6,500 L per day	None
Reverse Osmosis	100 L per day	100 L per day	None
Mechanical Processing	1,500 kg per hour	1,500 kg per hour	None
Other Treatment	30 kg per hour	30 kg per hour	None

Source: SNL/NM 1997a
gal: gallon
HBWSF: High Bay Waste Storage Facility
kg: kilogram
L: liter
RMWMF: Radioactive and Mixed Waste Management Facility
[a] Treatment options are discussed in the SNL/NM Site Treatment Plan. Final approval of treatment options is not expected prior to the renewal of the existing hazardous waste permit sometime after 2000. The DOE has paid annual operating fees associated with the treatment units since 1996.

Table 4.12–3. Radioactive Waste Generated from 1992 through 1995[a]

RADIOACTIVE WASTE GENERATED[b]	LLW	TRU	LLMW	MTRU
1992	42	0	6	0
1993	40	0	7	0
1994	54	0	2	0
1995	45	0	18	0

Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] Values are in cubic meters, rounded to two significant digits
[b] It was assumed that the amount of waste placed into storage correlates to the amount of waste generated during a similar period of time.

Table 4.12–4. 1996 Radioactive Waste Generation by Major Contributors and Special Projects[a]

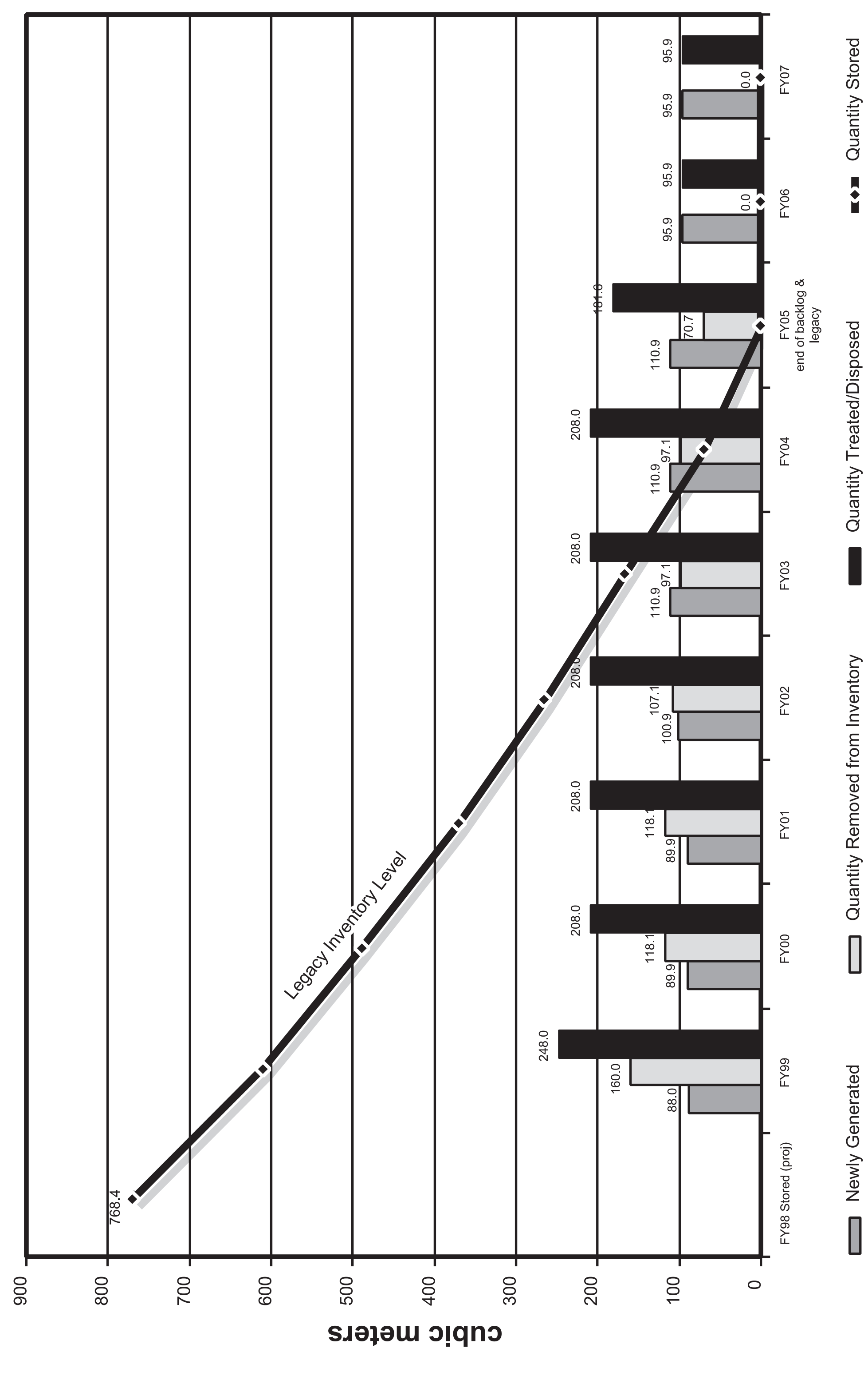
GENERATORS	LLW	LLMW	TRU	MTRU
Environmental Restoration Project[b]	310	62	0	0
Neutron Generator Facility, Building 870 and Related Production Activities	11	<0.1	0	0
Research Accelerator Facilities, TA-IV	0.3	0	0	0
Research Reactor Facilities, TA-V	140	6	4	0
Decontamination and Decommissioning	31	4	0	0
Waste Management of Legacy Waste	11	71	0	0
Other (Balance of Plant)[c]	74	0.3	0	0
TOTALS	**577**	**143**	**4**	**0**

Source: SNL/NM 1997a
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic waste
TA: technical area
TRU: transuranic waste
[a] Values are in cubic meters, rounded to two significant digits.
[b] Special program, not a component of normal operations
[c] Balance of operations refers to generation of mission-related waste not otherwise accounted for under selected facilities or special projects.

Table 4.12–5. Hazardous Waste Generated During Normal Operations from 1992 through 1995[a]

YEAR ACCEPTED AT HWMF	RCRA	TSCA
1992	147,000	5,000
1993	96,000	5,500
1994	86,000	24,000
1995	207,000	133,000

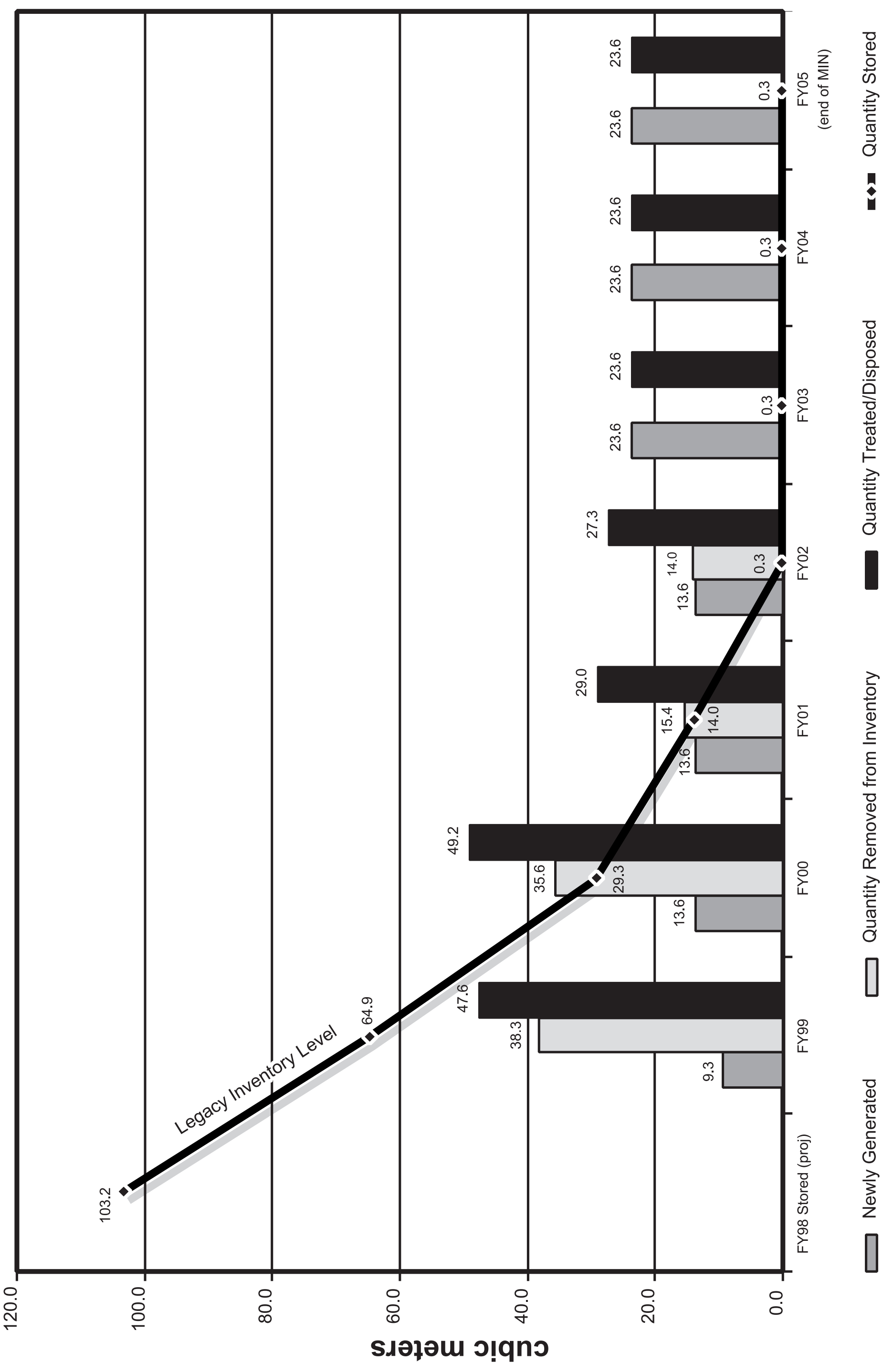
Source: SNL/NM 1997a
HWMF: Hazardous Waste Management Facility
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] Quantities given in kilograms
Note: Large variations may be attributable to startup and closeout of projects and relocation of laboratories from one building to another.



Source: Losi 1998

Figure 4.12–1. Projected Low-Level Waste Inventory, Fiscal Years 1999 through 2007

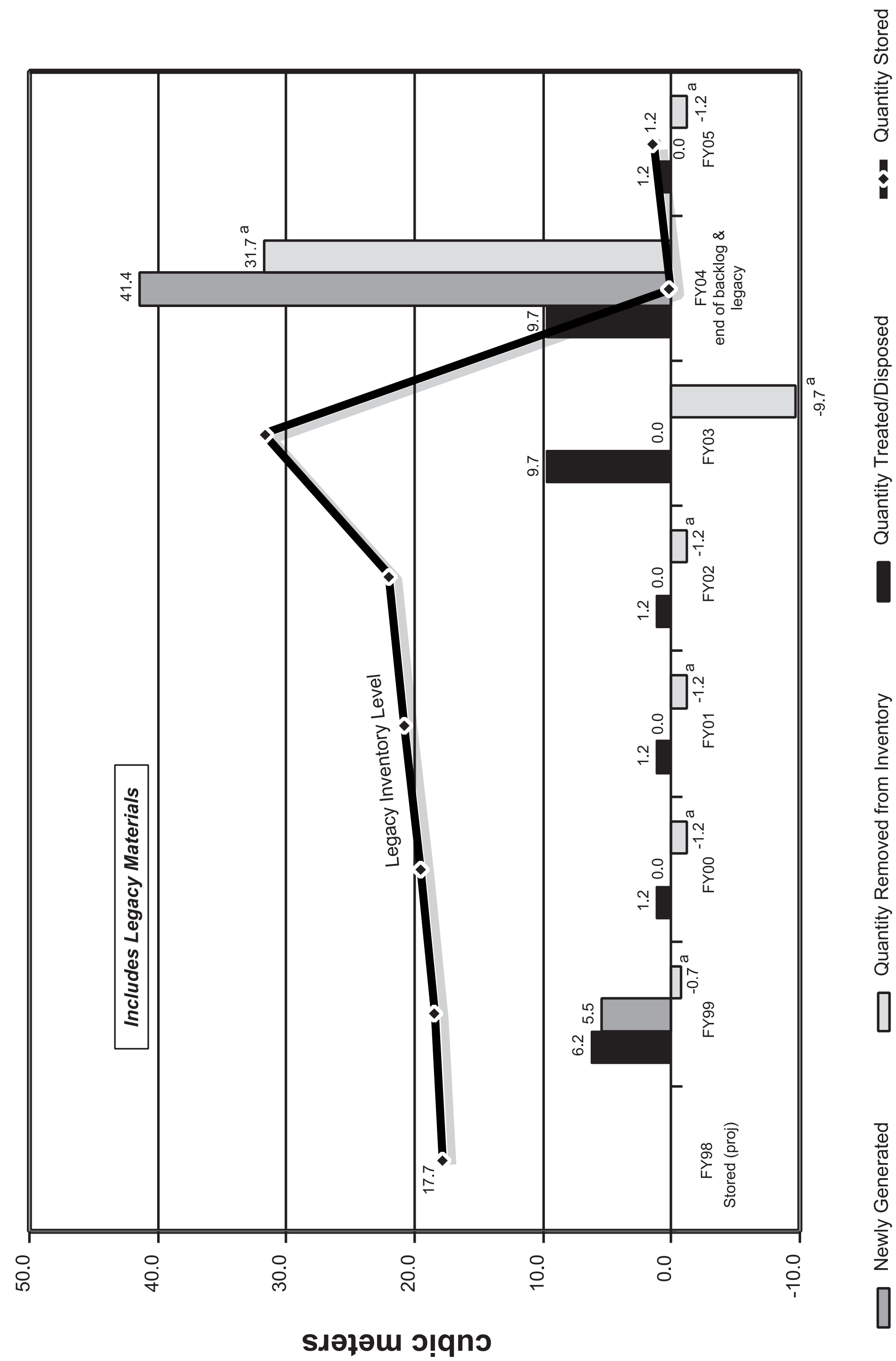
Legacy low-level waste inventory levels are projected to decrease to zero by 2005.



Source: Losi 1998

Figure 4.12–2. Projected Low-Level Mixed Waste Inventory, Fiscal Years 1999 through 2005

Legacy mixed waste inventory levels are projected to decrease to zero by 2002.



Source: Losi 1998

[a] Negative values for Transuranic and Mixed Transuranic indicate waste is placed into storage with no shipments occurring, resulting in an increase in inventory.

Figure 4.12–3. Projected Transuranic and Mixed Transuranic Waste Inventory, Fiscal Years 1999 through 2005

Transuranic waste volume is projected to increase through 2003 and then decrease by 2005.

totals generated in these years are unavailable. Prior to 1996, ER and D&D wastes were included within the RCRA and TSCA waste categories.

Current Hazardous Waste Generation

Table 4.12–6 presents data on hazardous waste generated by major programs in 1996 and some subgroups of major waste-generating programs or facilities. The programs or facilities listed in the table are the highest contributors. The remainder of RCRA-regulated hazardous waste is generated by approximately 1,000 additional onsite hazardous waste generators. Figure 4.12–4 shows projected quantities of SNL/NM-generated RCRA hazardous waste declining through 2001.

The PCB waste generation for 1996 was unusually high due to transformer replacement activities. An additional 77,000 kg of other TSCA waste, primarily asbestos, were generated predominantly from D&D asbestos abatement projects. Finally, 1,400 kg of biohazardous waste were also generated by the Medical Department. Figures 4.12–5 and 4.12–6 show historic asbestos waste generation and PCB waste generation with projections through 2002 (see Section 4.12.3.3 for additional information).

Explosive Waste

Explosive waste is a specific class of hazardous waste, RCRA characteristic code D003, that, due to its inherent danger, is addressed separately. Only one facility at SNL/NM, the TTF, is permitted under RCRA to treat this class of waste onsite. The TTF was specifically designed to treat explosive-contaminated waste, which did not meet DOT requirements for offsite transportation, from the Light Initiated High Explosive Facility. The TTF RCRA permit allows for treatment of up to 300 lb of waste per year. In 1996, 5,634 kg of explosive wastes were also sent to the KAFB Explosives Ordinance Disposal Unit.

4.12.3.6 Solid Waste

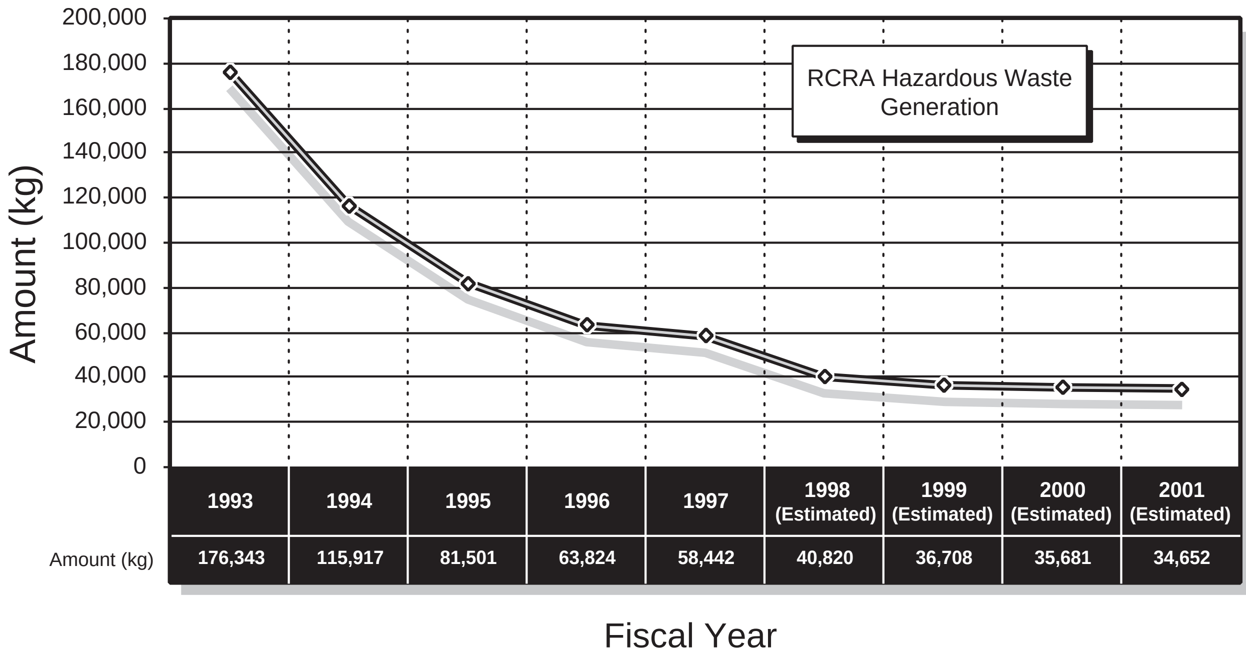
Solid waste consists predominantly of office and nonhazardous laboratory trash. It does not include food waste from cafeteria operations, which is managed under a separate contract with the USAF. Nonhazardous building debris generated from D&D activities may also be considered solid waste; however, it is currently managed at KAFB. After nonhazardous trash is transferred to the SWTF, it is screened for improperly disposed of and potentially hazardous materials, which are removed from the trash and disposed of through appropriate processes. All solid waste is currently disposed of at the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico.

Table 4.12–6. Major Hazardous Waste (RCRA and TSCA) Generators in Calendar Year 1996[a]

GENERATOR	RCRA	TSCA[b]
Environmental Restoration Project[c]	11,000	90
Neutron Generator Facility	220	680
Research Accelerators Facilities, TA-IV	1,100	41
Research Reactors Facilities, TA-V	110	460
Integrated Materials Research Laboratories	2,400	0
Compound Semi-Conductor Research Laboratory	2,000	0
Advanced Material Processing Laboratory	10,000	0
Other Generators	21,170	50,700
TOTALS	**48,000**	**52,000 (PCBs)[d]** **77,000 (Asbestos)[e]**

Source: SNL/NM 1997a
D&D: decontamination and decommissioning
PCBs: polychlorinated biphenyls
RCRA: *Resource Conservation and Recovery Act*
TA: technical area
TSCA: *Toxic Substance Control Act*

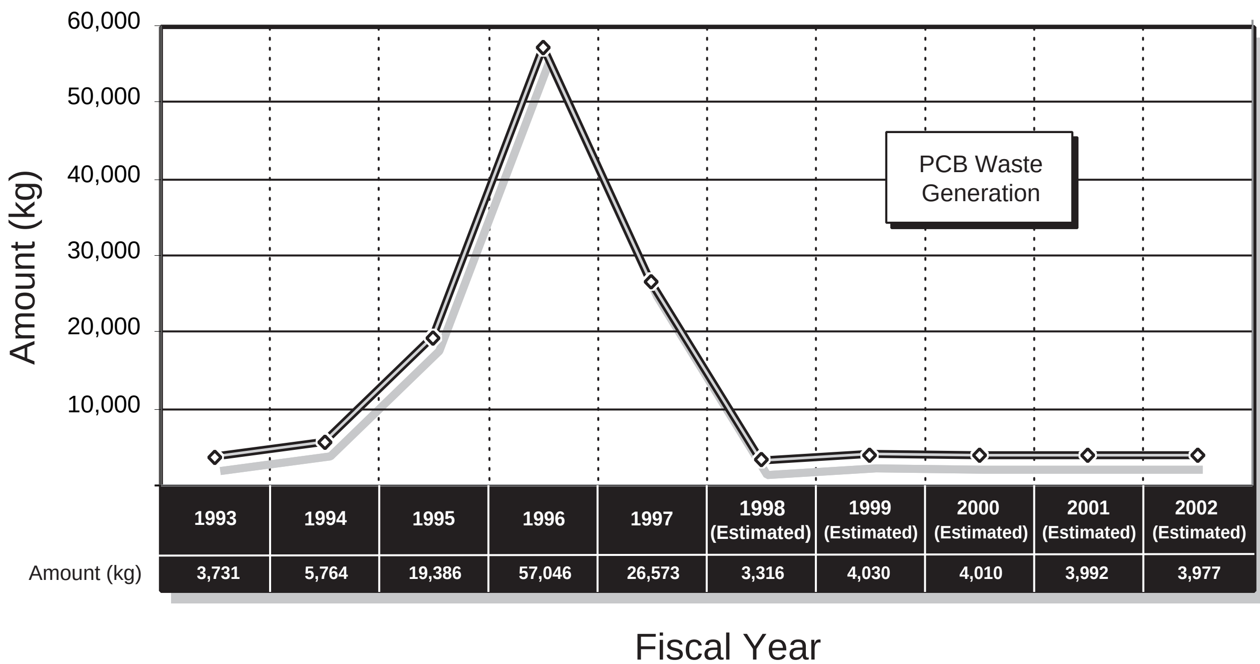
[a] Quantities given in kilograms
[b] PCBs unless otherwise noted
[c] The Environmental Restoration Project is a special program and not considered part of normal operations at SNL/NM.
[d] PCB generation for 1996 was unusually high due to transformer changeout.
[e] Asbestos generation predominantly was from D&D asbestos abatement projects.



Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–4. RCRA Hazardous Waste Generation

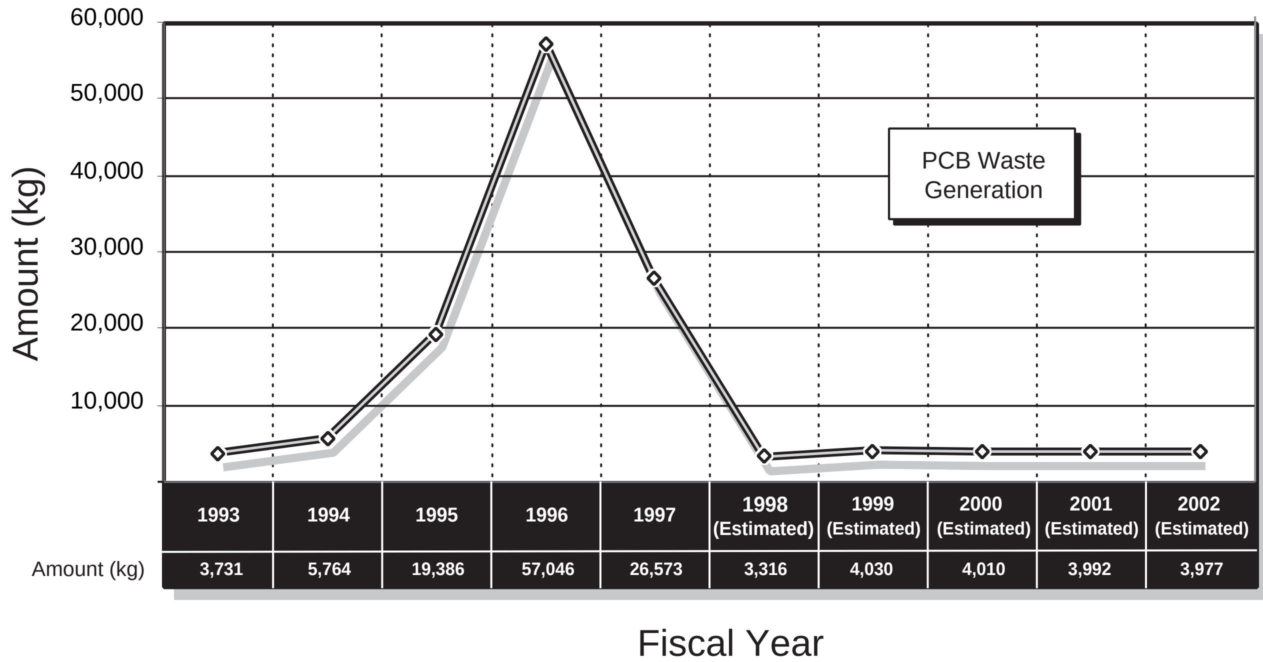
RCRA hazardous waste generated at SNL/NM would continue to decline through 2001.



Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–5. Asbestos Waste Generation

Volumes of asbestos waste generated at SNL/NM would remain constant through 2002.



Fiscal Year	1993	1994	1995	1996	1997	1998 (Estimated)	1999 (Estimated)	2000 (Estimated)	2001 (Estimated)	2002 (Estimated)
Amount (kg)	3,731	5,764	19,386	57,046	26,573	3,316	4,030	4,010	3,992	3,977

Sources: Losi 1998, SNL/NM n.d. (d)

Figure 4.12–6. Polychlorinated Biphenyls (PCB) Waste Generation

Volumes of PCB waste generated at SNL/NM would remain constant through 2002.

Historic Solid Waste Generation

Before August 1, 1994, solid waste was disposed of at the KAFB Solid Waste Landfill. From August 1, 1994, through May 13, 1996, the SNL/NM Solid Waste Management Program was in transition—the KAFB Landfill closed (except for nonhazardous construction and demolition waste and recyclable landscape debris) and SNL/NM built the SWTF.

During this transition, solid waste pickup and disposal was under contract to a commercial waste management company that transported from the pickup sites to the city of Albuquerque Cerro Colorado Landfill, initially, and then to the Rio Rancho Sanitary Landfill in Rio Rancho, approximately 28 mi from KAFB. On May 13, 1996, SWTF began screening waste. Since 1996, SNL/NM solid waste has been disposed of at local municipal landfills. Detailed records of disposal before August 1, 1994, are limited.

Current Solid Waste Generation

Table 4.12–7 presents information for solid waste generation from normal operations based on the period the SWTF operated from May through December 1996. In 1997, SNL/NM generated 51 solid waste shipments, totaling 1.1M kg or 2,100 m^3 (2,700 yd^3).

4.12.3.7 Pollution Prevention and Waste Minimization

DOE 5400.1 and Executive Order (EO) 12856 implement a pollution prevention program to comply with DOE requirements (58 FR 41981). The SNL/NM Pollution Prevention Program applies to all pollutants generated by routine and nonroutine operations. The scope of the Pollution Prevention Program includes activities that encourage pollution or waste source reduction and recycling, resource and energy conservation, and affirmative procurement of EPA-designated recycled products.

Trends and Requirements

Since 1993, SNL/NM has reduced waste generation, water use, and air emissions and has increased recycling and procurement of recycled material. Figure 4.12–7 presents 1997 recycling information for SNL by material type.

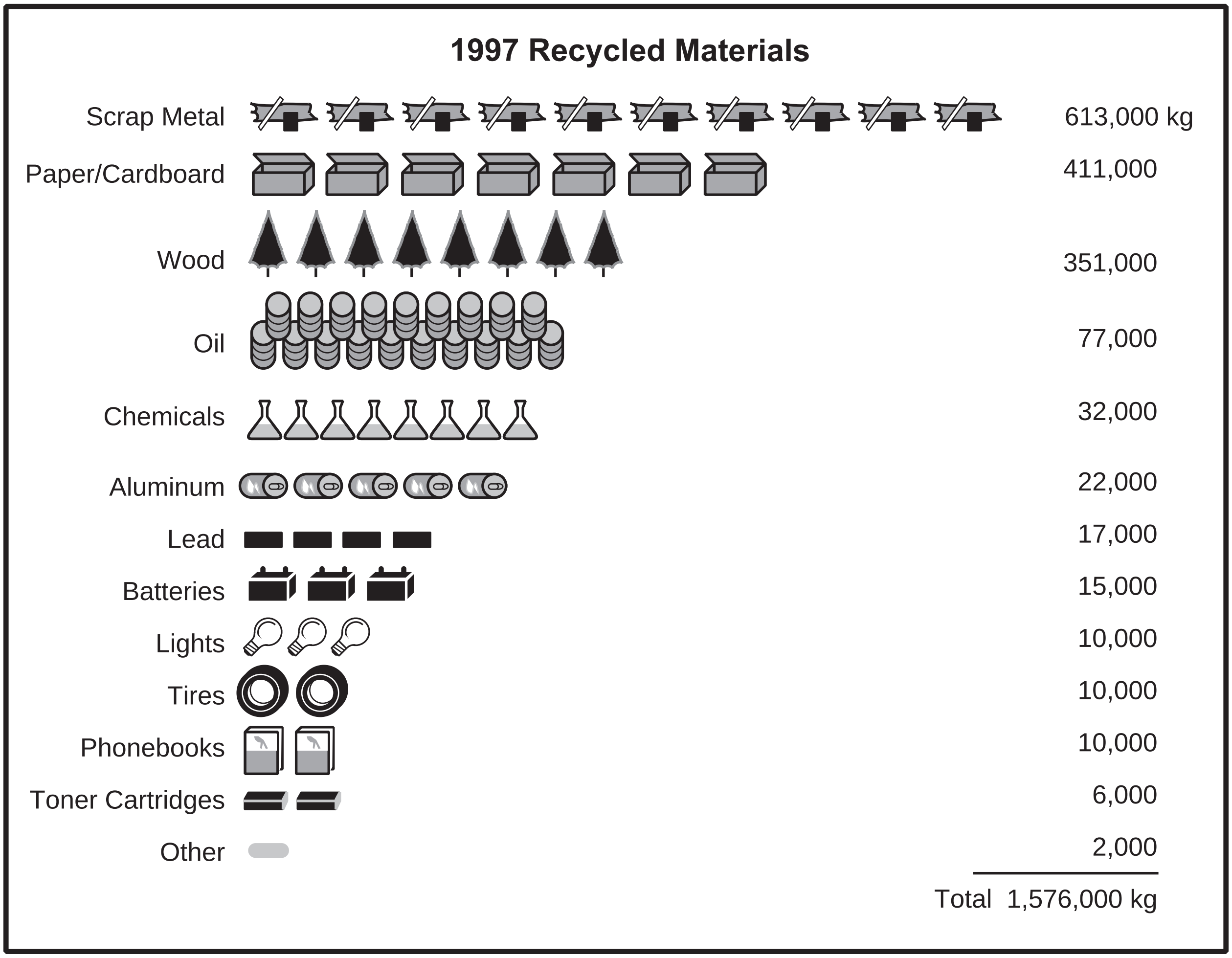
Waste Minimization

Waste minimization activities are not included in the previous descriptions to bound maximum waste projections for any given year. Actual waste trends are shown for RCRA hazardous, TSCA PCB, and TSCA asbestos wastes in Figures 4.12–4, 4.12–5, and 4.12–6. Actual figures for waste recycled are shown in

Table 4.12–7. 1996 Solid Waste Generation (Partial-Year Information)

DESCRIPTION	WEIGHT (kg)
Dumpster waste generated from May 13, 1996, through December 31, 1996	0.6 M
Average monthly dumpster waste generation	0.1 M
Average annual dumpster waste generation, estimated	1.1 M

Source: SNL/NM 1997a
lb: pound
M: million



Source: SNL 1998d

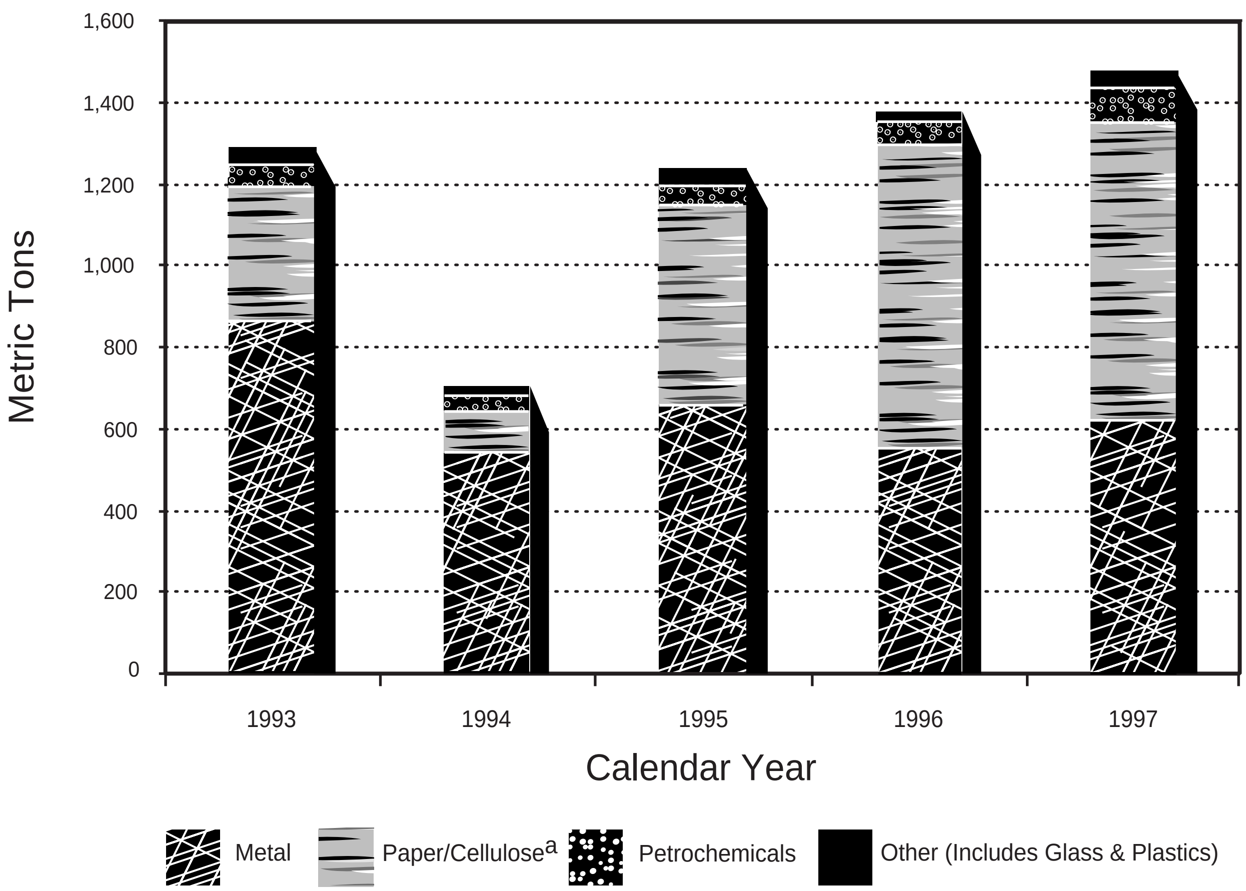
Figure 4.12–7. SNL Recycling in 1997

SNL has reduced waste generation through recycling.

Figures 4.12–7, 4.12–8, and 4.12–9. Prevention and minimization of waste generation and conservation of energy, water, and resources are the overall goals of this program.

The following wastes are tracked to determine SNL/NM's effectiveness in reducing wastes: LLW and LLMW, RCRA, state-regulated, TSCA, and sanitary waste. In addition, reductions of resource, water, and energy use are tracked. Following are the goals to be completed:

- Limit the generation of routine LLW to 20 m^3.
- Limit the generation of routine RCRA hazardous waste to 50 metric tons.
- Limit the generation of routine state-regulated chemical waste to 110 metric tons.
- Limit the generation of routine sanitary waste to 3,650 metric tons.
- Limit the generation of routine LLMW to 2.65 m^3.
- Increase the recycling rate to 33 percent of total sanitary waste generated.
- Increase procurement of EPA-designated recycled products to 100 percent in 1999, except where they are not commercially available competitively at a reasonable price or do not meet performance standards.
- Reduce annual energy use per square foot in regular buildings by 30 percent from FY 1985 to FY 2005. Assume a linear step reduction per year (for example, a 21 percent reduction by FY 1999).
- Reduce annual energy use per square foot in energy-intensive buildings by 20 percent from FY 1990 to FY 2005. Assume a linear step reduction per year (for example, a 12 percent reduction by FY 1999).
- Reduce water use at SNL/NM by 30 percent from 1994 to 2004. Assume a linear step reduction per year (for example, a 15 percent reduction by FY 1999).

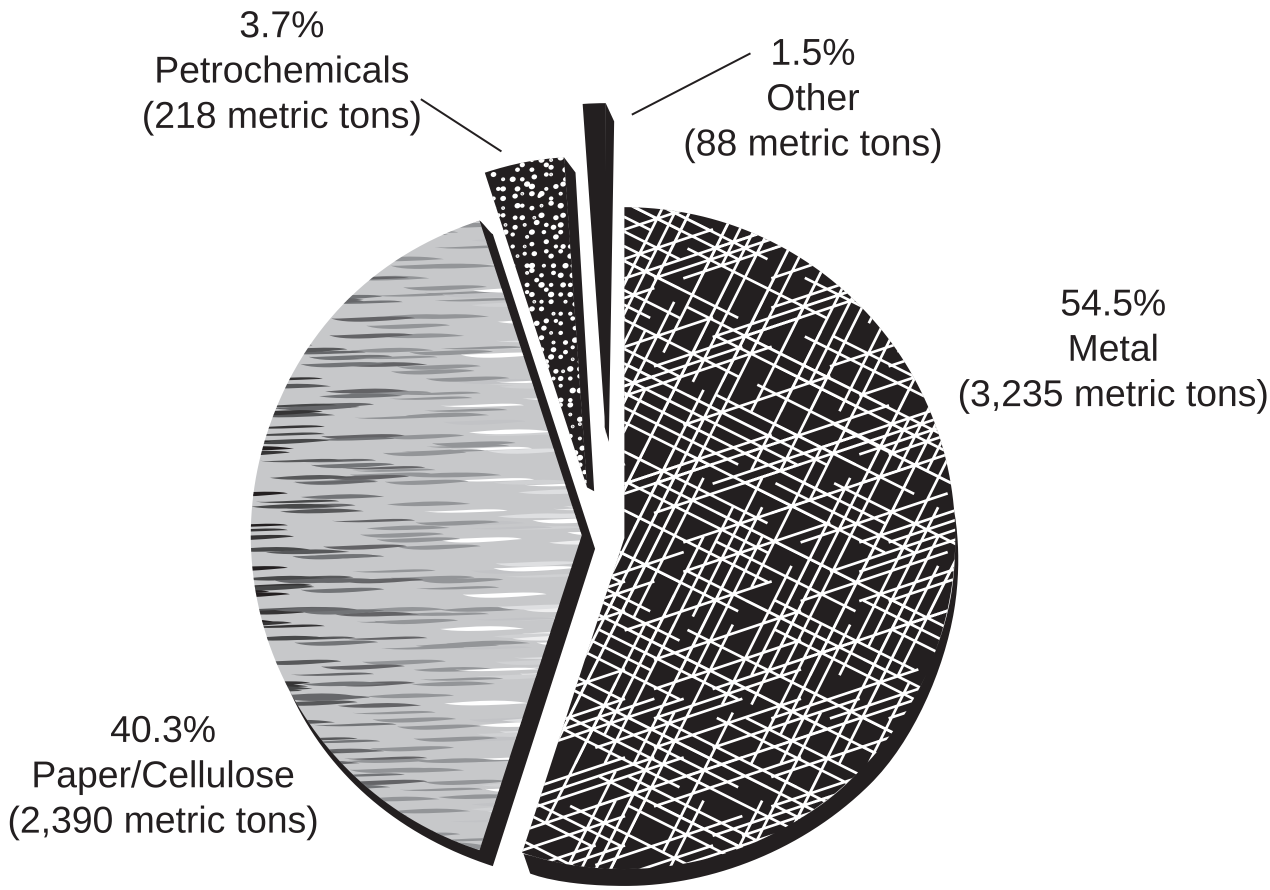


Source: SNL/NM 1998x

[a] Paper/cellulose quantities for 1996 and 1997 include amounts from LANL, the USAF, and other DOE activities at KAFB. For 1997, SNL/NM accounted for 51 percent of the recycled quantity, with LANL, the USAF, and other DOE accounting for 43, 3, and 3 percent, respectively.

Figure 4.12–8. Annual Recycling Trends, 1993 through 1997

SNL/NM annually recycles various material types.



Source: SNL/NM 1998x

Figure 4.12–9. Proportions of Recycled Materials, 1993 through 1997

Paper, cellulose, and metal comprise 95 percent of the material recycled at SNL/NM from 1993 through 1997.

Recycling

Recycled paper and cardboard are processed through the SWTF. In 1996, SNL/NM initiated a joint effort with Los Alamos National Laboratory (LANL) to cooperate in collecting, processing, and marketing LANL-generated recyclable paper. After creating a process, the program was expanded to include the Kirtland Area Office (KAO). Over the next few years, efforts to expand cooperation with other Federal and state facilities will continue.

4.13 NOISE AND VIBRATION

4.13.1 Definition of Resource

Noise is sound that is undesirable because it interferes with speech, communication, or hearing; is intense enough to damage hearing; or is otherwise annoying. Airblast noise from the detonation of explosives is impulsive in nature and generally lasts less than 3 seconds. The rapid onset of impulse noise or the vibration of buildings and other structures induced by a noise impulse can be annoying or discomforting to those around it.

Vibration is defined as a motion in which an object moves back and forth from its rest position when it is acted upon by an external force. The maximum ground-borne vibration level recommended by the U.S. Bureau of Mines to prevent threshold damage is 0.5 inches per second. The threshold level at which minor structural damage may begin to occur in 0.01 percent of structures is set at 2.0 inches per second. Noise from explosive detonations can cause buildings to vibrate, which is perceived by the occupants as shaking of the structure and rattling of the windows. These vibrations are perceived by the residents as the cause of existing or potential structural damage. The probability of this shaking causing structural damage is minimal.

Quantifying the Effects of Sound

The process of quantifying the effects of sound begins with establishing a unit of measure that accurately compares sound levels. The physical unit most commonly used is the decibel (dB). The decibel represents a relative measure or ratio to a reference pressure. The reference pressure is a sound approximating the weakest sound that a person with very good hearing can hear in an extremely quiet room. The reference pressure is 20 micropascals, which is equal to 0 (zero) dB.

A-weighted sound levels (dBA) are typically used to account for the response of the human ear. A-weighted sound levels represent adjusted sound levels that are made according to the frequency content of the sound.

4.13.2 Region of Influence

The ROI associated with noise includes the area within the Albuquerque basin. Noise decreases with distance from the source. The sound heard outside KAFB from airblast noise, resulting from the detonation of explosives or sonic booms from sled track activities, resembles a dull thud or short burst of sound. The distance at which this sound can be heard depends on the intensity of the initial airblast, the meteorological conditions, terrain, and background noise levels.

4.13.3 Affected Environment

This section describes the sources of noise resulting from activities conducted at SNL/NM and those associated with activities at KAFB and Albuquerque International Sunport. Although noise from activities at KAFB and the Sunport is not related to SNL/NM activities, it could affect SNL/NM operations.

Baseline sounds at SNL/NM consist of manufactured noise generated in and around the surrounding area, mainly from transportation and stationary sources. Activities at and around SNL/NM affect ambient (background) sound. These include aircraft associated with Albuquerque International Sunport and KAFB, vehicular traffic at KAFB, and industrial sources. SNL/NM test programs, including tests of high explosives, rocket motors, and large-caliber weapons and tests producing sonic booms, contribute to the noise baseline.

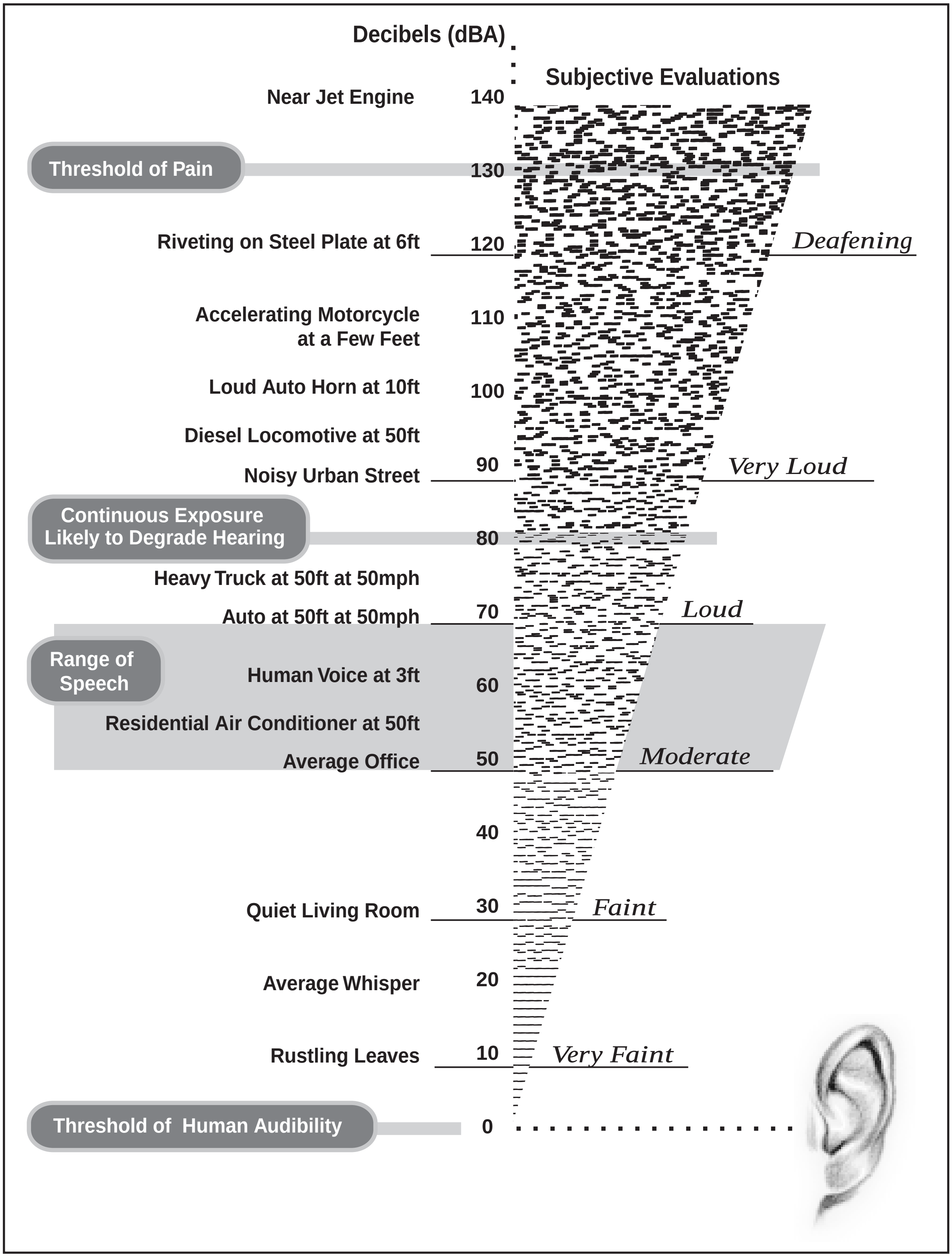
Noise effects to the community depend on the loudness of the sound, the intensity of vibrations, the frequency of the events, and the atmospheric conditions transmitting sound during the event. In most cases, the impulse sound heard outside KAFB resembles a dull thud or a short burst (less than 3 seconds). The noise baseline (aircraft, traffic, and industrial sources) would mask the sounds produced by most SNL/NM activities.

Industrial and construction activities are another source of noise. Some of these activities could affect the occupational health of SNL/NM personnel, but measures are in effect through the SNL/NM Hearing Conservation Program to ensure that hearing damage to personnel does not occur.

The regulatory setting that applies to noise at SNL/NM includes the *Noise Control Act of 1972* (42 U.S.C. § 4901), *Contractor Industrial Hygiene Program* (DOE 5480.10), *Occupational Noise Exposure* (29 CFR §1910.95), and *City of Albuquerque Noise Control Ordinance* (Ord. 21-1975, § 9-9-1).

4.13.3.1 SNL/NM Ambient Noise Levels

The ambient noise level is the sound pressure level of the all-encompassing noise associated with a given environment, usually a composite of sounds. Figure 4.13–1 shows a noise scale representing common noise events, the respective decibel (dB) level, and a subjective evaluation of the noise event.



Source: Original

Figure 4.13–1. Comparing Noise Levels to Events Within Range of Human Hearing

Decibel levels and subjective evaluations are compared for events within range of human hearing.

SNL/NM's ambient background sounds will be relatively consistent. Background sounds produced by generators, air conditioning, ventilation systems, vehicles, and employee activities constitute a substantial sound source during the morning, midday, and evening. The range of background noise levels associated with these sources is from 50 to 70 dB (SNL/NM 1997a).

SNL/NM testing produces the most perceptible impulse sound levels at TA-III, Coyote Test Field, and other outdoor test facilities. The 1996 baseline frequency of impulse noise events is 1,059 events. Only a small fraction of these events are loud enough to be heard or felt beyond the site boundary.

No residential areas on KAFB or in the city of Albuquerque are affected by either the damaging vibration area of 2.0 inches per second or the annoyance vibration area of 0.2 inch per second. SNL/NM facilities within the damage radius for vibrations are designed to withstand the effects of testing; therefore, damage would be unlikely (SNL/NM 1997a).

4.13.3.2 Ambient Noise Levels at Other Locations

SNL/NM is subject to aircraft noise from the Albuquerque International Sunport and KAFB and from vehicular traffic on KAFB. Aircraft noise is the most prevalent sound because Runway 8-26 is the primary runway for the Albuquerque International Sunport. Aircraft take off and land in an easterly direction on this runway about 75 to 80 percent of the time. Aircraft using this runway fly directly over SNL/NM. Noise abatement procedures to decrease aircraft noise in nearby neighborhoods, such as Ridgecrest and Four Hills, affect SNL/NM (SNL/NM 1997a). These procedures direct pilots to avoid these neighborhoods by flying over SNL/NM.

Noise levels at SNL/NM associated with aircraft from the Albuquerque International Sunport are too low to be considered potentially damaging to hearing. The noise is primarily annoying, interrupting conversations, telephone communications, and possibly the ability to concentrate on difficult tasks. Personnel in temporary buildings, such as trailers, are more likely to be affected because of the poor sound absorption qualities of the building materials in comparison to permanent buildings.

Based on Federal Aviation Administration (FAA) land use compatibility guidelines, adverse effects on people are most likely to occur within the 75-dB(A) day-night average noise level (DNL) area.

At the Albuquerque International Sunport, the 65-dB(A) and 70-dB(A) noise levels extend beyond the Sunport boundary with KAFB (SNL/NM 1997a), but not the 75-dB(A) noise level.

Motor vehicle noise is prevalent in the more congested areas of KAFB. The fluctuation of traffic noise over long periods is associated with peak traffic periods. In addition, noise levels are influenced by vehicle type, number of tires, road-surface conditions, and exhaust systems. The DNL in a 1995 KAFB traffic study in a 24-hr traffic count at the Gibson gate was 71 dB(A), averaged over a 24-hr period (SNL/NM 1997a).

The Air Force Research Laboratory, USAF/Explosive Ordnance Disposal (EOD), and the Defense Special Weapons Agency detonate explosives on KAFB. Activities that are not SNL/NM's are performed at the Giant Reusable Air Blast Simulator (GRABS) Site, Chestnut Site, High Energy Research Test Facility (HERTF) Site, USAF/EOD areas, and the DOE Live Fire Range.

Harmful noise levels (above 140 dB) from these activities remain within the boundaries of KAFB, with the exception of an 1,800-lb high-explosive detonation at the Chestnut Site, for which the 140-dB noise level extends beyond the KAFB site boundary and into the buffer zone on the Pueblo of Isleta (SNL/NM 1997a). Explosive detonations of this magnitude are expected to be rare.

Future development in the buffer zones on the Pueblo of Isleta and Mesa del Sol will create potential conflicts with respect to land use. Noise levels are projected to affect the buffer zones during high-explosive detonations at the Chestnut Site. Ground vibration may be of sufficient magnitude to generate structural damage if development occurs in the buffer zones. Impulse noise may affect the area, producing annoyance to inhabitants of developed areas should the land-use status change from its current buffer zone designation.

Day-Night Average Sound Level

The day-night average sound level (DNL) was developed to evaluate the total community noise environment. The DNL is the average A-weighted sound level during a 24-hr period, with 10 dB added to nighttime levels (between 10:00 p.m. and 7:00 a.m.). This adjustment is added to account for the increased human sensitivity to nighttime noise events.

4.14 SOCIOECONOMICS

4.14.1 Definition of Resource

This section describes the demographic and economic variables associated with community growth and development that have the potential to be directly or indirectly affected by changes in operations at SNL/NM. SNL/NM and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required by SNL/NM operations. SNL/NM operations, in turn, create the demand and pay for the people, goods, and services in the form of wages, salaries, and benefits for jobs and dollar expenditures for goods and services. The measure of the communities' ability to support the demands of SNL/NM depends on their ability to respond to changing environmental, social, economic, and demographic conditions.

For a discussion of DOE operations and socioeconomic effects related to DOE operations at SNL/NM, see Section 6.2.

4.14.2 Region of Influence

The socioeconomics ROI is defined by the areas where SNL/NM employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The ROI consists of a four-county area (Bernalillo, Sandoval, Torrance, and Valencia counties) and includes the city of Albuquerque, which is where approximately 97.5 percent of SNL/NM employees reside (Figure 4.14–1). The ROI is also defined in *The Economic Impact of Sandia National Laboratories on Central New Mexico and the State of New Mexico, Fiscal Year 1996*, prepared by New Mexico State University (NMSU) for the DOE Office of Technology and Site Programs, DOE/AL (DOE 1997j). The FY 1997 report was reviewed; however, FY 1996 remained the year most representative of past operations. FY 1997 data are presented for comparison.

4.14.3 Affected Environment

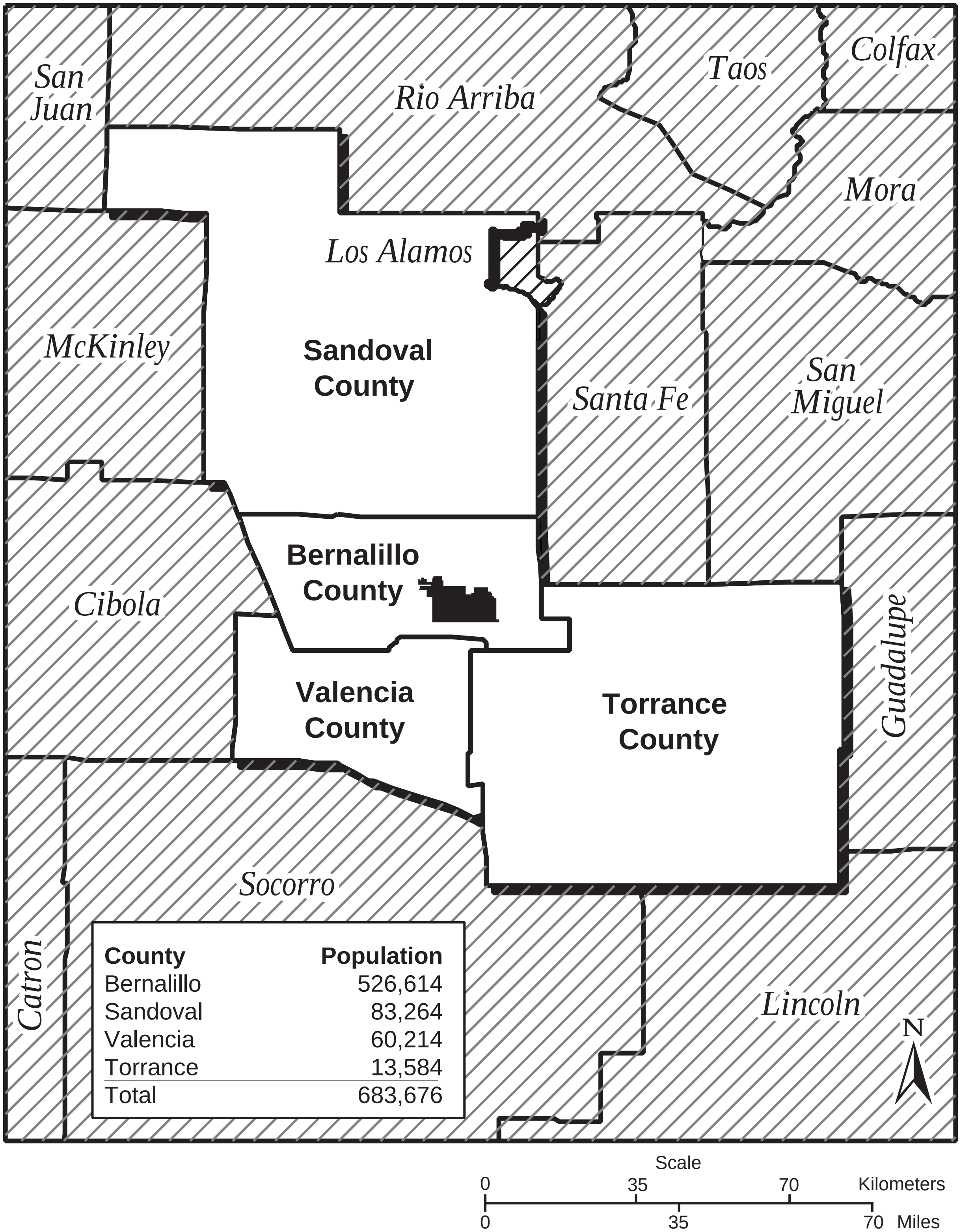
4.14.3.1 Demographic Characteristics

The estimated population in the four-county ROI in 1990 was approximately 599,416 people, of whom approximately 80 percent (480,577) reside in Bernalillo county. The predominant population in the ROI is white, although 37.1 percent of the total population have a Hispanic ethnic background (Table 4.14–1). Native Americans residing in the ROI account for 5 percent of the general population. The Pueblos of Cochiti, Isleta, Jemez, San Felipe, Sandia, Santa Ana, Santo Domingo, and Zia, and the Cañoncito Navajo Reservation are important centers of these Native American populations (Census 1995) within the ROI. In 1990, minorities made up 45.4 percent of the total ROI population and 49.6 percent (not shown in table) of the state population (based on revised 1990 census data). In April 1997, out of a total work force of 6,824 workers, minorities made up 27.4 percent of the SNL/NM work force, including 1,325 Hispanic, 203 Native American, 184 Black, and 155 Asian workers (SNL/NM 1997h).

According to the Bureau of the Census, the ROI population grew from 599,416 in 1990 to 683,676 by July 1, 1996, which is an increase of 83,260 people or 14.1 percent over the 1990 count (Census 1997a) (Table 4.14–1). Figure 4.14–2 shows population projections to 2010. Bernalillo county has attracted the highest population growth, a trend that is likely to continue. Sandoval and Valencia counties, however, have been increasing at faster rates than Bernalillo county, and probably will continue to grow at a faster percentage increase than Bernalillo, with Sandoval doubling in population by 2020. The growth of the Albuquerque area is increasingly affecting a multi-county region. The social and economic activities of Sandoval, Torrance, and Valencia counties are becoming more intertwined with Bernalillo county as urbanization increases. The most concentrated development is expected to be in the Rio Grande valley, but northwest Torrance county will also become increasingly developed (MRGCOG 1997b).

Some 62.4 percent of the population in the ROI is between the ages of 18 and 65. Approximately 81 percent of this population has completed high school, and 24.5 percent has attained a 4-year or higher college degree (Census 1995) (Table 4.14–1).

The 1989 total, median, and per capita income levels of the population in the ROI were approximately $7.8 B, $27,392, and $12,935, respectively (Table 4.14–1). While both the median and per capita income levels of the ROI were close to the respective state averages of $24,087 and $11,246, there are substantial differences in income levels among the counties, especially between Torrance county (at the low end) and Bernalillo county (at the upper end) (Table 4.14–1) (MRGCOG 1997b). At the time of the 1990 Census, an estimated 15.1 percent of the residents in the ROI were living below the official poverty thresholds. Poverty thresholds vary by size of family and number of



Source: Census 1997a

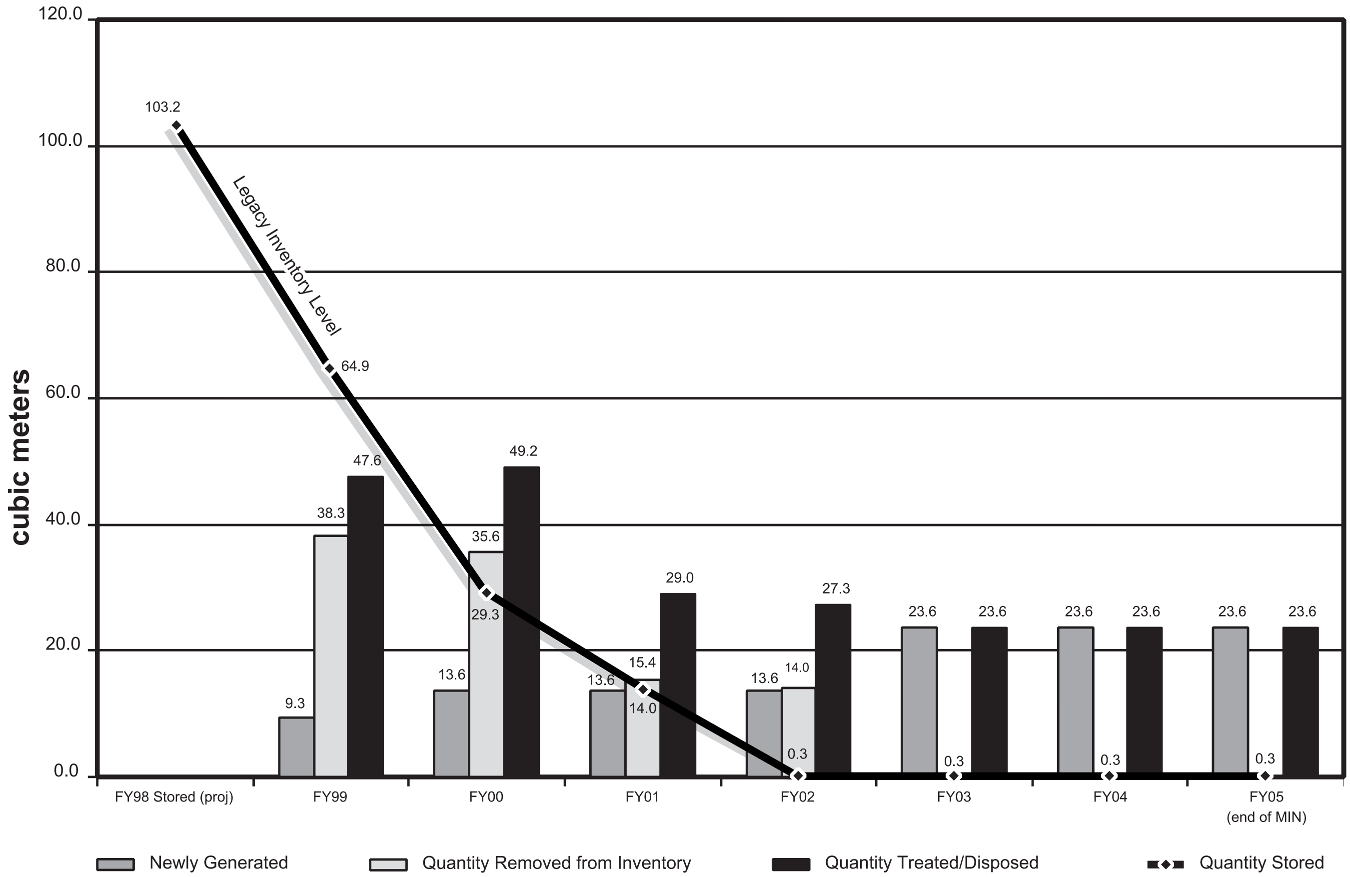
Figure 4.14–1. Four-County ROI Population

The socioeconomic region of influence encompasses Bernalillo, Sandoval, Torrance, and Valencia counties.

Table 4.14–1. Demographic Profile of the Population in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
POPULATION					
1996 Population (Est.)	526,614	83,264	13,584	60,214	683,676
1990 Population	480,577	63,319	10,285	45,235	599,416
Population Change from 1990 to 1996	46,037	19,945	3,299	14,979	84,260
RACE (1990)					
Percent of Total Population					
White	76.9	68.6	87.0	77.5	76.2
Black	2.7	1.5	0.4	1.1	2.4
Native American	3.4	19.7	1.2	2.9	5.0
Asian/Pacific Islander	1.5	0.8	0.2	0.4	1.4
Other[a]	15.5	9.4	11.1	18.1	14.9
Percent Minority (1990)	44.2	48.8	39.5	54.3	45.4
Ethnicity (1990)					
Hispanic	178,310	17,372	3,892	22,733	222,262
Percent of Total Population	37.1	27.4	37.8	50.3	37.1
AGES (1990)					
Percent Under 18	26.1	32.0	32.1	30.8	27.2
Percent 65 and Over	10.5	10.1	11.4	10.1	10.4
Percent Between 18 and 65	63.4	57.9	56.5	59.1	62.4
EDUCATION (1990) PERSONS 25 YEARS AND OLDER					
Percent High School Graduate or Higher	82.1	79.3	72.6	73.3	81.0
Percent Bachelor's Degree or Higher	26.7	19.1	10.9	12.1	24.5
MONEY INCOME (1989)					
Total Income ($1,000)	6,511,338	686,948	92,051	463,387	7,753,724
Median Household Income ($)	27,382	28,950	19,619	24,312	27,392
Per Capita Income ($)	13,594	10,849	8,950	10,244	12,935
Percent of Persons Below Poverty Line (1989)	14.6	15.6	21.1	19.0	15.1

Sources: Census 1995, 1997a; MRGCOG 1997a; UNM 1997a
ROI: region of influence
[a] According to the Bureau of the Census, in the 1990 Census, the "Other" category included persons identifying themselves as multiracial, multiethnic, mixed, interracial, or a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican).



Source: UNM 1997b

Figure 4.14–2. 1995 Population Estimates and Projections to 2010

Population increases are projected for each of the four counties from 1995 through 2010, with the total region of influence population increasing by 27 percent.

related children under 18 years of age. In 1989, for example, the official poverty threshold for a family of four was $12,674. In 1989, 21 percent of the state population was identified as in poverty or designated as having low income (Census 1996).

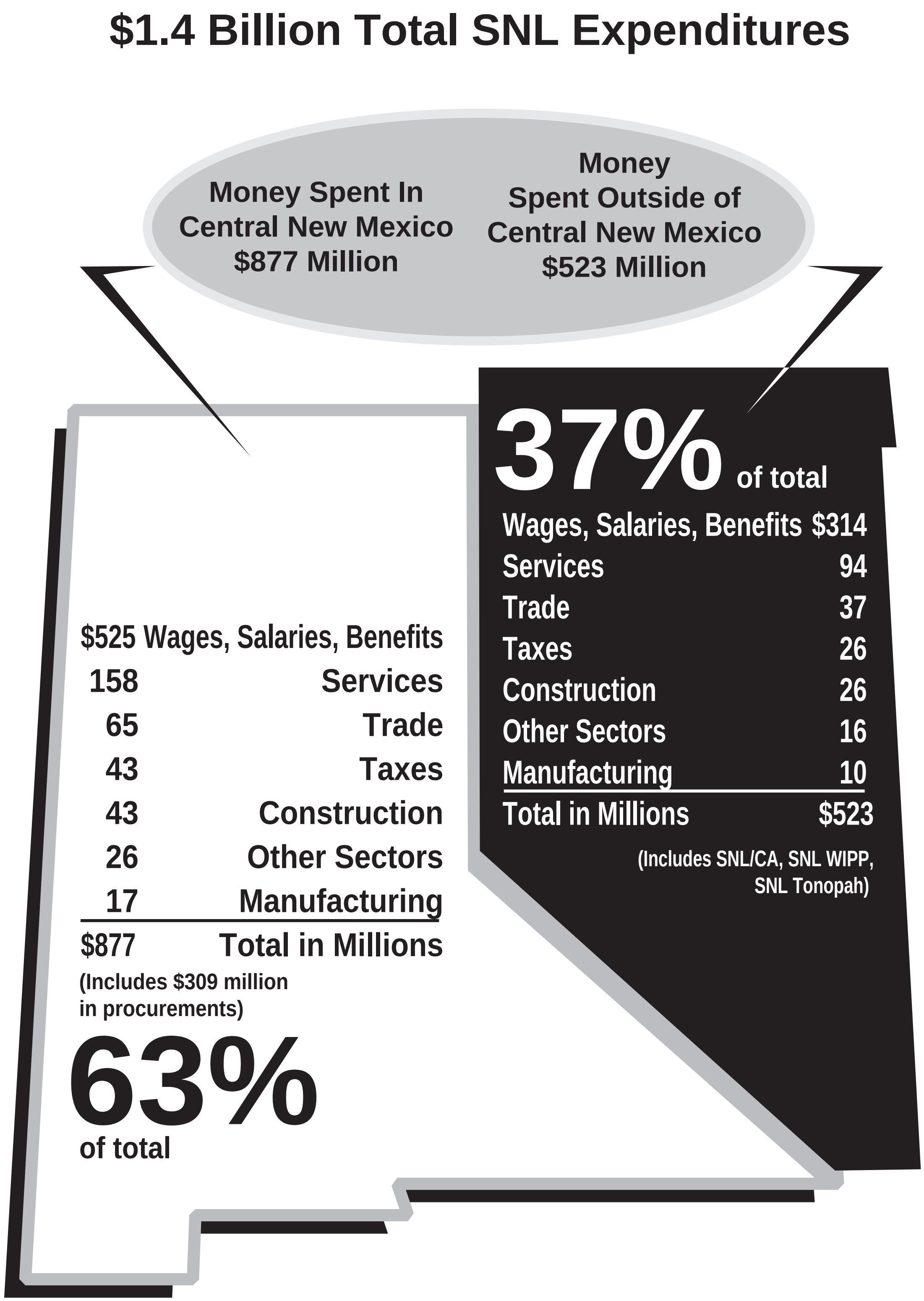
4.14.3.2 Economic Base

SNL/NM is the fifth-largest private employer in New Mexico and the third largest in the ROI. Its direct economic impact on the ROI is substantial even after deducting procurement and wage/salary payments made outside the ROI. For FY 1997, the SNL/NM payroll for the ROI was $417 M for 6,824 full-time personnel (DOE 1997j). During the same year, SNL/NM spent approximately $309 M in procurements (Figure 4.14–3) in the ROI (DOE 1997j). Therefore, $726 M ($417 M + $309 M) in direct income was available for households and businesses to create jobs and make additional purchases of products and services inside or outside the ROI. Table 4.14–2 lists employment and income in the ROI.

The total number of employed civilian workers in the ROI in 1996 was 331,800 (363,192 in 1997 [DOE 1998j]). In 1996, Sandoval, Torrance, and Valencia counties had a combined overall average unemployment rate of 5.8 percent, which was higher than Bernalillo county (5.3 percent) and the ROI as a whole (5.4 percent) (Table 4.14–2) (UNM 1997c). Torrance county had the highest unemployment rate (8.9 percent). Employment changes at SNL/NM could have a greater socioeconomic effect on Bernalillo and Torrance counties (Figure 4.14–3), where members of the SNL/NM workforce comprise a higher percentage of the county population and civilian labor force in comparison to the other counties.

The pattern of employment and income are different from county to county. During 1996, employment and per capita income were highest in Bernalillo county, followed in descending order by Sandoval, Valencia, and Torrance counties (Table 4.14–2).

In 1995, service industries comprised the largest employment sector in Bernalillo county (108,172 employees



Source: Original

Figure 4.14–3. Total Operating and Capital Budget at SNL

Of the total operating and capital budget for SNL for FY 1996, $877 M was spent in central New Mexico and $523 M was spent outside of central New Mexico.

Table 4.14–2. Employment and Income Profile in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
LABOR FORCE 1996					
Number of Workers	281,408	38,101	5,668	25,587	350,764
Employed	266,434	35,986	5,162	24,218	331,800
Percent Unemployed	5.3	5.6	8.9	5.4	5.4
SNL/NM WORK FORCE 1997					
Number of Workers	5,846	311	160	336	6,653[a]
Percent of Total SNL/NM Work Force[a]	85.7	4.6	2.3	4.9	97.5
Percent of 1996 Population	1.1	0.4	1.2	0.6	1.0
PERSONAL INCOME (BEA)					
Total Personal Income 1995 ($1,000)	11,901,977	1,387,695	183,339	898,055	14,371,066
Per Capita ($)	22,718	17,349	14,229	15,622	21,341
SNL/NM Net Wages and Salaries (FY 1996) ($1,000) (Not Including Benefits)	366,712	19,509	10,037	21,077	417,335

Sources: SNL/NM 1997h; UNM 1997c, d
BEA: Bureau of Economic Analysis
FY: fiscal year
ROI: region of influence
SNL/NM: Sandia National Laboratories/New Mexico
[a] Total SNL/NM workforce was 6,824 on April 13, 1997, of which 171 employees lived outside the ROI. Thus, only 6,653 workers are shown on this table.

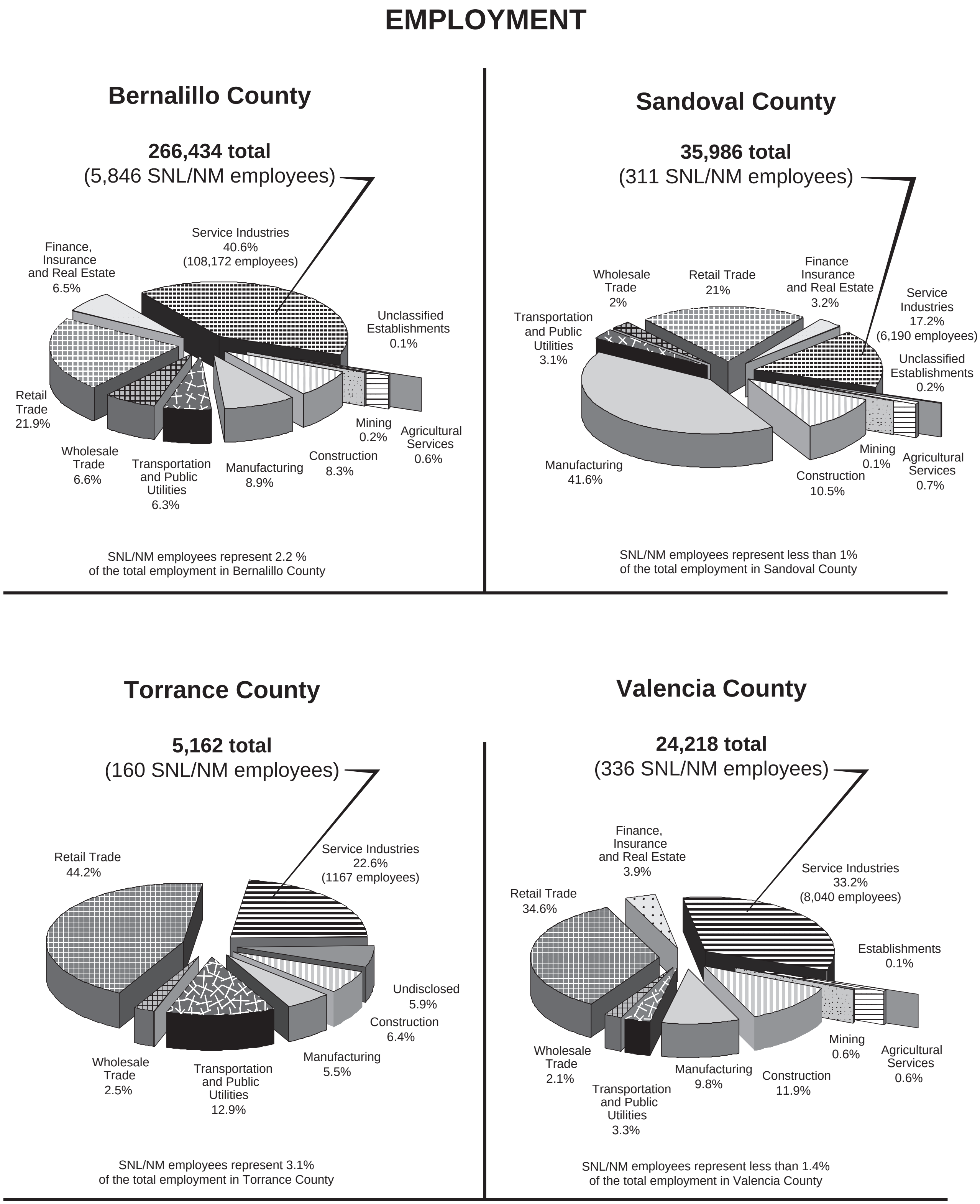
or 40.6 percent), of which the health, engineering, management, and business sectors were the largest contributors. Retail trade accounted for another 21.9 percent, followed by manufacturing (8.9 percent) and construction (8.3 percent) (Figure 4.14–4). Manufacturing was the largest employment sector in Sandoval county in 1995 with 41.6 percent, followed by the retail trade and service industries sectors accounting for 21 percent and 17.2 percent, respectively. The retail trade sector provided the most employment in Torrance county (44.2 percent) and Valencia county (34.6 percent), followed by the service sector in both counties (22.6 percent and 33.2 percent, respectively) (Census 1997b).

The total operating and capital budget for SNL/NM for FY 1996 was approximately $1.4 B ($1.38 B in 1997), of which an estimated $877 M ($840.5 M in 1997) was spent in central New Mexico. SNL/NM expenditures by major sectors for FY 1996 were personnel, including benefits ($525 M); services ($158 M); trade ($65 M); government ($43 M); construction ($43 M); other sectors ($26 M); and manufacturing ($17 M) (Figure 4.14–4). As Figure 4.14–3 illustrates, $523 M of the $1.4 B was spent outside of New Mexico and $314 M was spent on salaries, wages, and benefits. In FY 1996, $94 M of SNL/NM expenditures went for services, $37 M for trade, $26 M for government, $26 M for construction, $16 M for other sectors, and $10 M for manufacturing (DOE 1997j).

The flow of income and expenditures (such as procurements) from SNL/NM also generates direct revenue to state and local governments in the form of taxes, fees, and government services. In 1996, SNL/NM paid $43 M in revenue (mainly state and local taxes, fees, and government services) in New Mexico. An additional $26 M was paid in taxes to other government entities (outside New Mexico).

NMSU prepares an annual analysis of SNL/NM's economic impact on the state of New Mexico and the four-county ROI. In their analysis, NMSU employs an economic model that incorporates buying and selling linkages among regional industries and measures the impact of SNL/NM's expenditure of money in the ROI.

The NMSU model produces three multipliers. The first multiplier is used to calculate overall economic activity, the second calculates income, and the third calculates employment. These multipliers provide information needed



Source: Census 1997b

Figure 4.14–4. 1995 Employment in Four-County Region of Influence

The largest employment sectors in the four-county region of influence are service (Bernalillo), manufacturing (Sandoval), and retail (Torrance and Valencia).

to estimate SNL/NM's economic impact. The overall economic activity multiplier identifies the extent to which SNL/NM relies directly and indirectly on the ROI economy to provide materials, services, and labor it requires to conduct its operations. It also identifies the extent to which respending by businesses and industries occurs in the ROI. Income and employment multipliers make possible the identification of not only the direct impacts of an activity on income and jobs but also the indirect (business) and induced (household) effects (DOE 1997j).

SNL/NM operations in the ROI have substantial influence on the economy. The total funding for SNL was approximately $1.4 B in FY 1996. Using an overall economic activity multiplier of 2.75 (adjusted for central New Mexico) yields a total economic impact of $3.9 B within the ROI. Assuming $486 M net additional personal income ($525 M gross personal income) and using the 2.21 income multiplier, the total personal income was slightly less than $1.1 B in FY 1996, or approximately 8 percent of the personal income generated in the ROI. SNL/NM workers living in the ROI received approximately $417.3 M in net wages and salaries in FY 1996. For every job at SNL/NM, an estimated additional 2.46 jobs were created in the ROI, which means that the 6,653 average employment level in FY 1996 resulted in an additional 16,366 jobs. In effect, nearly 1 out of every 14 jobs in the ROI was created or supported by SNL/NM, or 23,019 out of 331,800 (DOE 1997j).

4.14.3.3 Housing and Community Services

Table 4.14–3 lists the total number of occupied housing units and vacancy rates in the ROI. In 1990, the ROI contained 246,561 housing units, of which 225,289 were occupied. The median value of owner-occupied units was $85,300 in Bernalillo county, which is higher than the other three counties and nearly twice the median value of units in Torrance county. Coincidentally, the vacancy rate was lowest in Bernalillo county (7.8 percent) and highest in Torrance county (24.8 percent). While both Bernalillo and Sandoval counties issued a high number of new housing permits between 1990 to 1992, Sandoval county had the highest percentage of permits in relation to the existing stock in 1990 (Census 1995).

Community services include public education and health care (hospitals, hospital beds, and doctors). In 1990, student enrollment totaled 165,719 in the ROI (Census 1995). Ninety-two percent of these students attended public schools. Community health services and facilities are concentrated in Bernalillo county.

SNL/NM is actively involved in the surrounding communities including the city of Albuquerque, Bernalillo county, and neighboring pueblos. SNL/NM is active with the following committees, boards, and/or organizations: Albuquerque Economic Development; Citizens Advisory Board for SNL/DOE; Greater Albuquerque Chamber of Commerce; and the United Way (SNL/NM 1997a). Other activities include work with educational institutions, community associations, and government agencies.

Measuring SNL/NM's Economic Impact on the ROI

A multiplier is a factor used to calculate the incremental effect of changes, in dollars spent or jobs created or lost, at SNL/NM. For example, the overall economic activity multiplier is used to calculate the total economic activity generated in the ROI for each $1 spent by SNL/NM. The income multiplier is used to calculate the total income generated in the ROI for each $1 of income paid to workers at SNL/NM. The employment multiplier is used to calculate the total number of generated jobs in the ROI for each job created at SNL/NM.

NMSU identified the following multipliers in their FY 1996 analysis (FY 1997 is in parentheses):

Overall Economic Activity Multiplier

- $1 spent by SNL/NM generates an additional $1.75 ($1.98), for a total overall economic impact of $2.75 ($2.98) in the ROI.

Income Multiplier

- $1 income from SNL/NM for workers generates another $1.21 ($1.32), for a total impact on income of $2.21 ($2.32) in the ROI.

Employment Multiplier

- 100 jobs created at SNL/NM generates another 246 jobs (264), for a total impact of 346 (364) jobs in the ROI.

Sources: DOE 1997j, 1998j

Table 4.14–3. Housing and Community Services in the Four-County Region of Influence

PARAMETERS	BERNALILLO	SANDOVAL	TORRANCE	VALENCIA	ROI
HOUSING (1990)					
Total Units	201,235	23,667	4,878	16,781	246,561
Occupied Housing Units	185,582	20,867	3,670	15,170	225,289
Median Value ($)	85,300	69,600	46,500	72,100	NA
Vacant Units	15,653	2,800	1,208	1,611	21,272
Vacancy Rate	7.8	11.8	24.8	9.6	8.6
New Housing Building Permits (1990-1992)	6,147	1,492	NA	490	NA
Percent of 1990 Housing Stock	3.1	6.3	NA	2.9	NA
PUBLIC EDUCATION (1990)					
Total School Enrollment	133,386	17,092	2,793	12,443	165,719
Elementary or High School	82,555	12,815	2,390	9,325	107,085
Percent Public	91.5	93.4	98.5	95.6	92.1
COMMUNITY HEALTH CARE (1991)					
Hospitals	10	0	0	0	10
Hospital Beds	1,726	0	0	0	1,726
Physicians (1990)	1,585	51	3	21	1,660

Source: Census 1995
NA : not available
ROI: region of influence

4.15 ENVIRONMENTAL JUSTICE

4.15.1 Definition of Resource

Presidential EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. Identifying minority and low-income populations is based on demographic and economic census information presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/New Mexico* 59 FR 7629, (SNL 1997f). The following sections summarize the information presented in that report.

4.15.2 Region of Influence

The population within a 50-mi radius around SNL/NM was considered in this evaluation because most resource areas have an ROI with the 50-mi radius, and none of them (with the exception of the four-county region for socioeconomics) has an ROI that extends beyond 50 mi. Minority populations living up to a 50-mi radius of SNL/NM, which exceed 49 percent of the population according to census data (Figure 4.15–1), were evaluated regarding health and environmental effects from activities at SNL/NM . Similarly, where low-income population exceeded 21 percent of the general population (Figure 4.15–2), the effects from activities at SNL/NM were analyzed. Figure 4.15–3 shows areas of high environmental justice concern located near KAFB main gates (SNL 1997f). The figure presents a composite assessment of both minority and low income populations as presented in *Addressing Environmental Justice Under the National Environmental Policy Act at Sandia National Laboratories/ New Mexico* (SNL 1997f).

4.15.3 Affected Environment

4.15.3.1 Identifying Minority and Low-Income Populations

For this SWEIS, minority populations are considered to be all *people of color,* except white people who are not Hispanic. In 1990, 49 percent (51 percent by 1996) of New Mexico's population was minority (Census 1998). Neighborhoods having minority population percentages exceeding the minority population percentage of 49 percent are identified on a block-by-block basis, with clusters of blocks known as block groups.

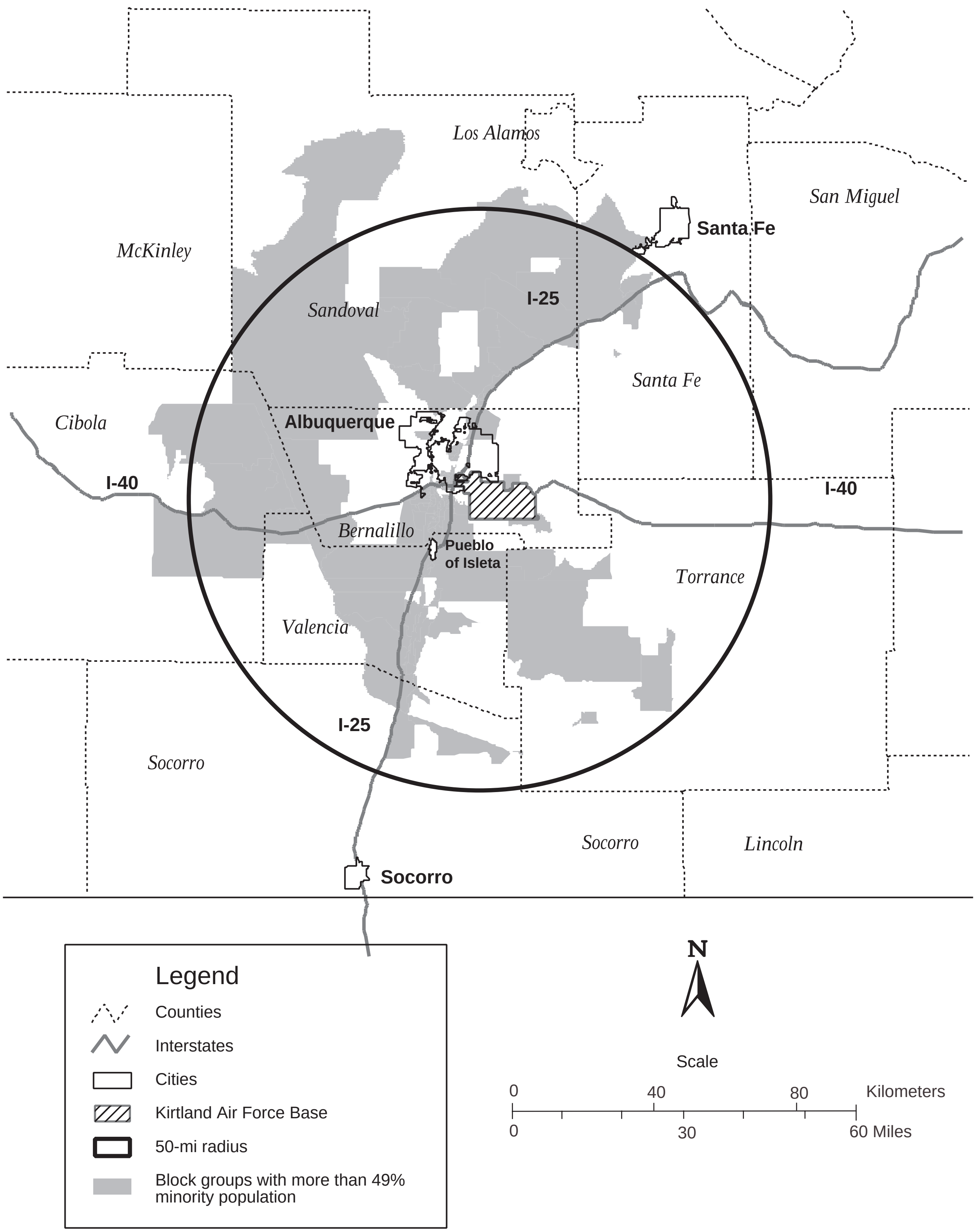
The Bureau of the Census characterizes persons in poverty (low-income persons) as those whose incomes are less than a statistical poverty threshold. The threshold is a weighted average based on family size and age of family members. For instance, the 1990 census threshold for a family of four was based on a 1989 household income of $12,674 (Census 1990). By 1996, the household income threshold rose to $16,036 (Census 1997c). In 1989, 21 percent of New Mexico's population was listed in poverty or designated as having low income (Census 1996). By 1996, the estimated percentage stood at 24 percent (Census 1997c). In this analysis, low-income block groups (same as above) occur where the low-income population percentage in the block group exceeds the poverty percentage for the state of New Mexico. Figures 4.15–1 and 4.15–2 show the percentages of minority populations and low-income individuals, respectively, living within a 50-mi radius of SNL/NM. This area is similar, but not identical to, the four-county socioeconomic ROI discussed in Section 4.14.

4.15.3.2 Minority Populations

Block groups containing fewer than 49 percent minority individuals were not considered minority block groups (SNL 1997f). According to 1990 census data, approximately 280,360 minority individuals from an approximate total population of 609,500 reside in the 50-mi ROI. This represents 46 percent of the total ROI population (SNL 1997f). Figure 4.15–1 shows the census block groups containing minority individuals.

Approximately 228,800 persons identified themselves as being of Hispanic origin, which represent approximately 37.5 percent of the ROI population (SNL 1997f). Areas of Hispanic population lie generally in historic settlement patterns west of Interstate 25, in areas called the North Valley and South Valley. In the North Valley, Los Ranchos de Albuquerque has a higher-than-state-average Hispanic concentration. Old Town, the original center of Albuquerque, also has a higher-than-state-average Hispanic concentration. The highest Hispanic concentration is in the South Valley (SNL 1997f).

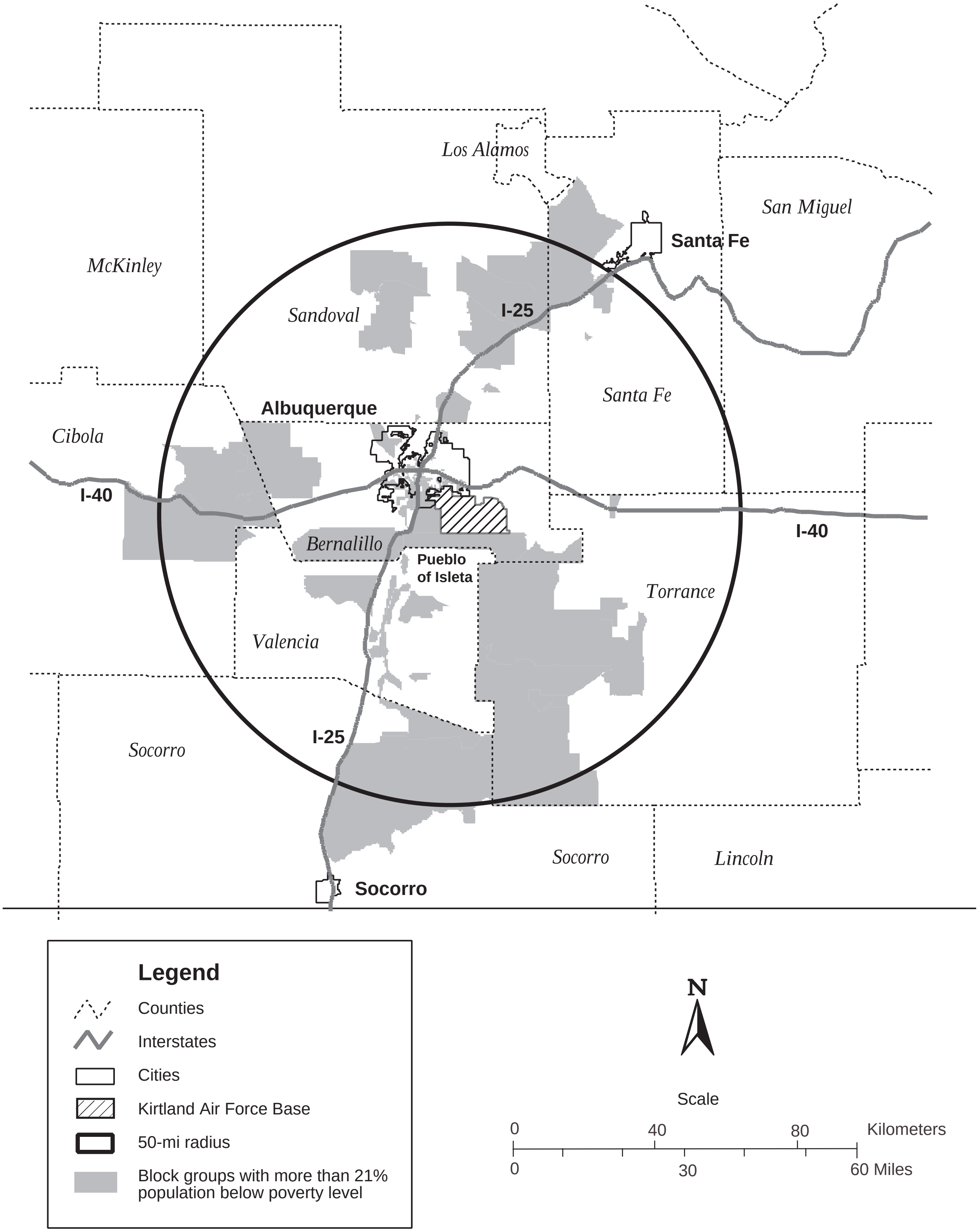
Approximately 29,840 persons identified themselves as "American Indians," which represent approximately 5 percent of the ROI population (SNL 1997f). The ROI contains 11 pueblos or reservations and 2 joint-use areas. The Pueblo of Isleta and Isleta Pueblo Trust Lands are adjacent to the southern boundary of KAFB. In addition, the Pueblo of Isleta represents the largest landholding of a minority population adjacent to KAFB (SNL 1997f).



Source: SNL* 1997f*

Figure 4.15–1. Minority Population

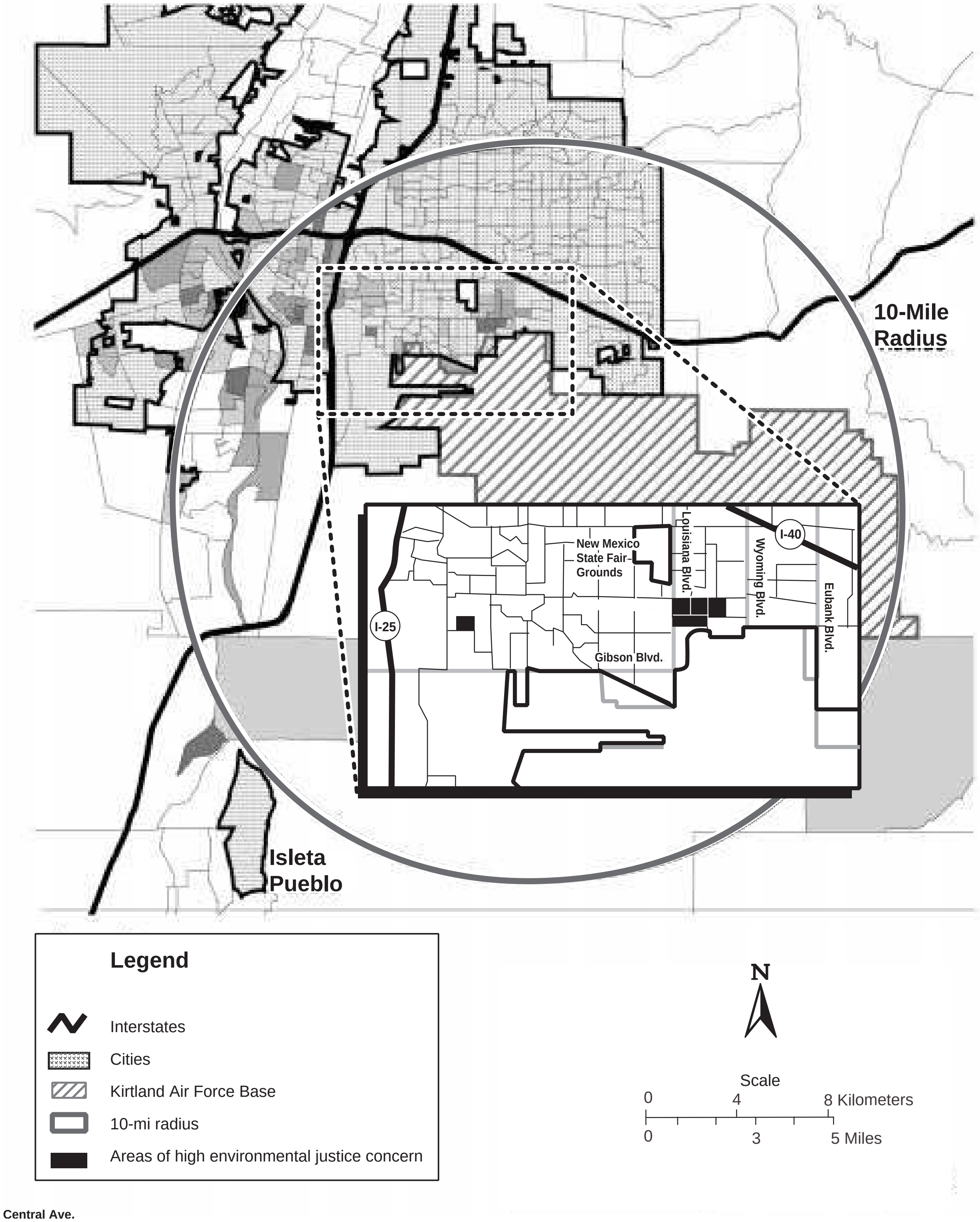
Block groups with more than 49 percent minority population were identified within a 50-mi radius of SNL/NM.



Source: SNL 1997f

Figure 4.15–2. Low-Income Population

Block groups with more than 21 percent low-income population were identified within a 50-mi radius of SNL/NM.



Source: SNL 1997f

Figure 4.15–3. Environmental Justice Areas

Five block groups (see inset) with potential high environmental justice concern are located near KAFB.

Another 8,025 persons identified themselves as being “Asian or Pacific Islander,” and approximately 14,600 persons identified themselves as being “Black,” which represent approximately 1 and 2 percent, respectively, of the ROI population. The highest concentrations of both these groups reside in base housing on or near KAFB. Several smaller Black communities also exist west of KAFB, just beyond the city’s airport (SNL 1997f).

An estimated 91,600 persons identified themselves as “Other,” which represent approximately 15 percent of the ROI population. Statewide, 190,350 persons identified themselves as “Other.” Of those people, approximately 186,970 (98 percent) were of Hispanic origin (SNL 1997f). This phenomenon occurs because many Hispanics do not consider themselves to be “White,” a category they perceive as designated for European-Americans. According to the Bureau of the Census, the “Other” category includes persons identifying themselves as multiracial, multiethnic, mixed, interracial, or of a Spanish/Hispanic origin group (such as Mexican, Venezuelan, Latino, Cuban, or Puerto Rican). Concentrations of “Other” populations to the west of SNL/NM are in Hispanic neighborhoods. The distribution of “Other” minority individuals near SNL/NM mirrors the distribution of Hispanic individuals (SNL 1997f).

4.15.3.3 Low-Income Populations

Approximately 85,330 persons were identified as being low income, which represent approximately 14 percent of the ROI population (SNL 1997f). Figure 4.15–2 shows the census block groups containing more than 21 percent population below the poverty level.

This distribution of low-income population has a strong correlation to minority populations of Blacks, Native Americans, and Hispanics. For example, the high concentrations of low-income populations west of Albuquerque, shown in Figure 4.15–2 (near the 50-mi radius boundary), indicate the Pueblo of Laguna and its outlying Native American villages. Similarly, portions of the Pueblo of Isleta, south of the city, have high percentages of low-income individuals. To the southeast of SNL/NM, the rural Hispanic villages of Tajique, Torreon, and Escobosa are also low-income. To the north of SNL/NM, high concentrations of low-income populations are located in the Pueblos of Jemez, San Felipe, Santo Domingo, and Cochiti, as well as in the rural Hispanic villages of La Cienega and Jemez Springs (SNL 1997f).

High concentrations of low-income populations occur west of SNL/NM, along the Rio Grande, in the predominantly Hispanic South Valley neighborhoods. In addition, small pockets of low-income populations reflect the locations of Black neighborhoods such as the Kirtland Addition and the South Broadway/East San Jose area (SNL 1997f).

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